LMU
Users Guide

Version 1.0.6
December 2009

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Table of Contents

Table of Contents **1**
1 Introduction **5**
1.1 About CalAmp – Who we are… 5
1.2 About CalAmp – What we do… 5
1.3 About this Manual 5
1.4 About the Reader 5
2 CalAmp LMU – Hardware Overview **6**
3 LMU Setup – Configuration Overview **7**
3.1 Parameters 7
3.1.1 What are Parameters? *7*
3.1.2 How does one program Parameters? *7*
3.2 S-Registers 9
3.2.1 What are S-Registers? *9*
3.3 Parameter Masking 10
3.3.1 What is Parameter Masking? *10*
3.3.2 What is a bit mapped parameter values? *10*
3.3.3 How is a mask used? *10*
4 Working with Inputs, Outputs and Power **11**
4.1 I/O Introduction 11
4.2 Input Types 11
4.2.1 Digital Inputs *11*
4.2.2 Motion Sensor Input *13*
4.2.3 Power State Input *13*
4.2.4 Battery Voltage Critical Input *13*
4.2.5 High Temperature Input *14*
4.2.6 The 1 Bit Bus *14*
4.2.7 Analog to Digital Inputs *15*
4.3 Output Types 16
4.3.1 Relay Outputs *16*
4.3.2 External vs. Internal Power Switch *17*
4.3.3 Enable / Disable Battery Charging *17*
4.3.4 LED Outputs *17*
4.4 Selecting the GPIO Function 18
4.5 Working with Sleep Mode 19
4.5.1 Configuring the Input Wake-Up Monitor *19*
4.5.2 Keeping the Expansion Port powered during sleep *20*
4.5.3 Keeping the Modem On during sleep *20*
4.6 Working with the Status LEDs 21
4.6.1 Input State and Satellite Count Mode *21*
4.6.2 Alternate LED Blink Code *22*
4.6.3 Disabling the Status LEDs *23*
4.7 Restoring values through a power cycle 24
5 Working with External Serial Devices **26**
5.1 Using the Host Port 27
5.1.1 Host Mode - AT Command Setup *27*
5.1.2 Host Mode – NMEA Output *28*
5.1.3 Host Mode – Dial-Up Networking *29*
5.1.4 MDT Mode *31*
5.2 Using the Aux Port 36
5.2.1 NMEA Mode *36*

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

5.2.2 *MDT Mode* ... 36
5.3 Using The Garmin NUVI or MacKenzie Labs DAD-A1214 ... 40
5.4 Using the Modem Port ... 41
5.4.1 *Selecting a Modem Driver* ... 41
5.4.2 *Configuring the Modem Port's BAUD Rate* ... 42
5.4.3 *Setting the dial string* ... 42
5.4.4 *Setting the network username and password* ... 43
6 Using the CalAmp Bluetooth Adapter (BTA) ... 44
6.1 Using the BTA as the Host Port ... 45
6.1.1 *NMEA Output* ... 45
6.1.2 *AT Command and Debug Output* ... 45
6.1.3 *Dial-Up Networking – Dial-Up Networking Profile* ... 46
6.1.4 *Dial-Up Networking – Serial Port Profile* ... 46
7 Working with Comm ... 47
7.1 Using a second Comm profile ... 47
7.2 GPRS context switching ... 47
7.3 Automatically resetting the wireless modem ... 48
7.3.1 *Send fail restart* ... 48
7.3.2 *Log activity restart* ... 49
7.3.3 *Connection monitoring* ... 49
7.3.4 *Querying the modem for network status* ... 50
7.4 PDP Context Reset ... 50
7.5 Network selection ... 50
7.5.1 *GPRS networks* ... 52
7.5.2 *CDMA networks* ... 52
7.5.3 *iDEN networks* ... 52
7.6 Controlling the Data Session ... 53
7.7 Updating the PRL ... 53
7.8 Back Off Algorithms ... 54
7.9 Working with the Outbound Socket ... 54
8 Controlling LMU Access ... 55
8.1 Service Enables ... 55
8.2 Access IP Address List ... 56
8.3 Remote Host IP Address List ... 57
8.4 Primary Port Password ... 58
8.5 AT Command Password ... 58
9 Working with GPS ... 60
9.1 NMEA Messaging ... 60
9.2 GPS Timeouts ... 60
9.2.1 *Last Known Timeout* ... 60
9.2.2 *GPS Lost* ... 60
9.2.3 *GPS Restart* ... 61
9.3 Pinning ... 61
9.3.1 *Enable / Disable pinning* ... 61
9.3.2 *Using Ignition to control Pinning* ... 61
9.3.3 *GPS Accuracy Threshold* ... 62
9.3.4 *GPS Fix Quality* ... 62
9.3.5 *The effects of Pinning* ... 62
9.4 Special Functions ... 63
9.4.1 *Receiver Mode* ... 63
9.4.2 *Enabling SBAS Support* ... 63
9.4.3 *Elevation Filter* ... 63
9.4.4 *Using Active or Passive GPS Antennas* ... 64
9.4.5 *Update Rate* ... 64
9.5 Local GPS Messaging ... 65

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

9.5.1 *Odometer Message* 65
9.5.2 *Position Update Message* 66
9.5.3 *GPS Debug Output* 68
9.6 Over-The Air Real-Time GPS Updates 68
10 CalAmp LMU Interface – LM Direct 69
10.1 Using the LM Direct Protocol 69
10.2 Inbound Settings 69
10.2.1 *Message Logging* 70
10.2.2 *Working with Retry Schedules – Inbound Retries* 71
10.2.3 *Working with Retry Schedules – Log Retries* 71
10.2.4 *Using Multiple Inbound Addresses* 72
10.3 Maintenance Settings 75
10.3.1 *Maintenance Delivery* 75
10.3.2 *Maintenance Configuration* 75
10.3.3 *Maintenance Interval* 75
10.4 Null Messaging 75
10.5 Changing the Local Port 76
11 CalAmp LMU Interface – SMS 77
11.1 Reporting Data via SMS 77
11.1.1 *SMS Event Report* 78
11.1.2 *SMS Text Status Message* 81
11.1.3 *SMS Text Message* 84
11.1.4 *SMS GPS Status Message* 85
11.1.5 *SMS Comm Status Message* 86
11.2 SMS Request Messages 88
11.2.1 *Unit Request Messages* 88
11.2.2 *SMS Parameter Message* 89
11.2.3 *Serial Message Request* 90
12 CalAmp LMU Interface – TAIP 91
12.1 TAIP Sentences 91
12.1.1 *General Sentence Structure* 91
12.1.2 *PV (Position Velocity) Sentence Structure* 92
12.1.3 *LN (Long Navigation) Sentence Structure* 92
12.1.4 *IO (Input / Output) Sentence Structure* 93
12.1.5 *Optional Fields* 93
12.2 TAIP Settings 96
12.2.1 *Enabling TAIP* 96
12.2.2 *Message Selection* 96
12.2.3 *Message Destination* 97
12.2.4 *Local Port* 97
12.3 TAIP Reporting 97
12.3.1 *Scheduled Reporting – Standard Mode* 98
12.3.2 *Scheduled Reporting – Directed* 98
12.3.3 *PEG Reporting* 98
12.3.4 *SMS Reporting* 98
13 LMU Maintenance 100
13.1 Mobile ID 100
13.2 Firmware Versioning 101
13.3 Configuration Versioning 101
13.4 Downloading Firmware 102
13.5 Downloading Firmware – Locally 102
13.5.1 *Local Firmware Upgrade* 102
13.5.2 *Local Firmware Upgrade – LMU-1000™* 103
13.6 Downloading Firmware – Remotely 104
13.6.1 *Remote Firmware Upgrade – LMU 1000™* 104

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

14 LMU Programming Examples 105
14.1 LMU Programming – Delivery Fleet 106
14.1.1 Project Overview 106
14.1.2 Project Proposal 106
14.1.3 LMU Setup – Planning 107
14.1.4 LMU Setup – Development 108
14.2 PEG Programming – Long Haul Trucks 112
14.2.1 Project Overview 112
14.2.2 Project Proposal 112
14.2.3 LMU Setup – Planning 113
14.2.4 LMU Setup – Development – LMU 4100™ 114
14.2.5 LMU Setup Development – LMU-1000™ 115
14.3 LMU Programming – Taxi System 116
14.3.1 Project Overview 116
14.3.2 Project Proposal 116
14.3.3 LMU Programming – Planning 117
14.3.4 LMU Setup – Development 118
Appendix A — Parameter Definitions 122
Appendix B — S-Register Settings 135
Appendix C — ASCII Chart 161
Hexadecimal to ASCII 161
Decimal to ASCII 161
Appendix D – HyperTerminal Setup 162
Appendix E - Windows Vista – Putty Setup 165
Logging data to file with PuTTY 167
Appendix F - Pairing to the LMU-4100 Using Windows Mobile 169
Appendix G - Adding a Modem Driver 170
Windows Vista 170
Windows XP 177
Windows Mobile 5.0 183
Appendix H – Creating a Dial-Up Networking Session 184
Windows Vista 184
Windows XP 192
Windows Mobile 200

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

1 INTRODUCTION

1.1 About CalAmp – Who we are…

Founded in 1981, CalAmp stands at the forefront of technology evolution as a result of strategic collaborations with forward thinking customers. By anticipating technology and industry trends, we rapidly develop cutting-edge solutions to help our customers effectively realize time and cost savings. Based on our long history of successful product deployment we help our customers by managing the entire product lifecycle - from design to manufacturing to implementation.

1.2 About CalAmp – What we do…

We are a recognized and trusted leader in satellite DBS technology, wireless networks, software application development, embedded computing and enterprise mobility. We are considered the solution industry's foremost specialist in networking applications, wireless technologies, digital multimedia delivery, residential broadband data delivery, healthcare and medical and public safety.

1.3 About this Manual

This guide is meant to be a comprehensive description of all features of the CalAmp LMU product lines and their associated peripherals. The only exceptions are features having to do with PEG or LM Direct. These features are described in the PEG™ Programming Guide and LM Direct Reference Guide. All hardware, activation and installation information can be found in the corresponding Installation Guides.

When a feature is common to all products the device will be referenced as the CalAmp LMU, or just LMU. When a feature is device specific, the full version of the device (LMU-4100™, LMU-2500™, LMU-1200™, etc…) will be used.

1.4 About the Reader

This document is intended for any personnel who are required to activate, configure and install an LMU. It is expected that the reader has some familiarity with vehicle hardware as well as basic knowledge of the Windows ™ operating systems. Specific knowledge of HyperTerminal and Windows Dial-Up Network is required.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

2 CalAmp LMU – Hardware Overview

In today's competitive market place, many companies rely on telemetrics in their business to remove or minimize the risks associated with vehicle investment, improving efficiency, productivity and reducing their overall transportation costs. CalAmp products offer easy solutions to a wide range of markets.

- **LMU-4100™**
  Cutting-edge location technology in an affordable device with the intelligence to help meet customer's ever changing needs
- **LMU-2500™**
  This ultra-sensitive tracking device is unrivaled in its class with next generation GPS technology at an economical price.
- **LMU-1200™**
  This economical, full-featured device was designed for easy and reliable installation and features an internal back-up battery
- **LMU-1100™**
  The LMU-1100™ is an economical, fully sealed vehicle tracking product designed for easy and reliable installation in recreational vehicles. The LMU-1100™ is an ideal solution for asset monitoring and theft recovery for motorcycles, snowmobiles and other outdoor recreational vehicles.
- **LMU-1000™**
  This economy class device provides economical asset management. The unit can be fully customized to meet the specific requirements of any particular application.
- **LMU-900™**
- This device is an ideal solution for automotive insurance, stolen vehicle, vehicle finance, auto rental and other automotive tracking applications.
- **MTU-100**
  This fully sealed mobile tracker is ideal for monitoring person assets such as patients, work force, VIPS and pets or mobile equipment and containers

Full details for each product can be found in their corresponding installation guide.

Copyright ©CalAmp DataCom Inc 2009

3 LMU Setup – Configuration Overview

This section describes how the LMUs store their configuration data and how they are programmed. The meaning of each parameter will be touched upon in the sections that follow. A complete listing of parameters and S-registers can be found in Appendix A and B respectively.

3.1 Parameters

3.1.1 What are Parameters?

Parameters are how the LMU stores any of its configuration items thus; any setting that can be changed is contained within a Parameter.

Parameters are made up of three values, an ID, an Index and a Value.

The Parameter ID describes what the Parameter is, how many Indexes are available and what data the Value should contain. As an example, the Inbound Address contains 4 Indexes and stores an IP address. Parameter ID values may range from 0 to 65535, though only certain values have any meaning.

In many cases there are multiple Values associated with a given Parameter ID, for example there are 16 possible PEG Timers. The Parameter Index indicates which of the Values you are attempting to access. Indexes start from 0 and range to N-1 where N is the total number of available Values. For example, the 16 PEG Timers would range from Index 0 (the 1st timer) to Index 15 (the 16th Timer). Indexes can range from 0-255 (technically). It is very important to make sure you do not exceed the maximum index value for a given Parameter as this may cause unexpected behaviors in the LMU.

The last piece of a Parameter is the Value. The Value contains the actual setting of the Parameter such as 15s for a Timer. Some Parameters support Values with multiple parts. The PEG Zone Parameter is a good example of this. The Value of a PEG zone is split into 6 parts, a latitude, a longitude, 2 distance values, a spare value and a hysteresis value. The contents of the Value of a Parameter are defined by the Parameter ID.

Please refer to Appendix A for a complete listing of Parameter IDs, their Index ranges and the Value definitions.

There is, however, one configuration item that is not stored in a Parameter, namely Geo-Zones (i.e. the points and polygon zones). They have their own separate programming interfaces which are discussed in the PEG Programmers Guide and the LM Direct Reference Guide.

3.1.2 How does one program Parameters?

Parameters are programmed in one of three ways, either via AT Commands using the AT$APP PARAM, via an LM Direct™ Parameter Message or via an SMS Parameter Message. This manual will always use the AT Command based means of programming

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Parameters. The LM Direct™ Parameter Message is described in the LM Direct™ Reference Guide. The SMS Parameter Message is described later in this document.

3.1.2.1 AT Commands

The AT$APP PARAM commands can be used to query or set Parameter Values. The set command generally looks like:

```
AT$APP PARAM <ID>, <index>, <value>
```

It should be noted that there can be more than one <value> field depending on the Parameter's definition. Each sub-Value is separated by a comma.

The query command takes two forms, query for a single Value of a specific Index or query for all Values.

To query a specific Value, you need to reference which Parameter Index you are looking for. The command would look as follows:

```
AT$APP PARAM? <ID>,<index>
```

If the <index> field is not provided, the LMU will responds with the 1st index (i.e. index 0). The response will look like:

```
<ID>,<index>,<value>
OK
```

To query all Values of a Parameter a wild card character is used in place of the Index. This command would look as follows:

```
AT$APP PARAM? <ID>,*
```

The response will look like:

```
<ID>,<index 0>,<value 0>
<ID>,<index 1>,<value 1>
. . .
<ID>,<index N>,<value N>
OK
```

For Parameters with a large number of Indices, such as the event list, it may not be possible to display all Parameters.

Like the programming command there may be more than one <value> field for a given parameter. Each value is separated by a comma. The one exception is masks. Mask values are not displayed in the query response but they are required in the programming command. Masks are discussed later in this document.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

The LMU does support several other AT Commands beyond the Parameter commands. The most common ones are mentioned through-out this document.

A terminal program such as HyperTerminal is generally used to issue AT Commands to the LMU. Please refer to Appendix D for instructions on establishing a connection.

3.1.2.2 Parameter Messages

Parameter Messages are a means of remotely changing the parameter values of an LMU remotely. They can be sent in one of two ways, either via SMS or via an LM Direct™ Parameter message.

SMS Parameter Messages are discussed in detail later in this document. LM Direct™ Parameter Messages are discussed in the LM Direct Reference Guide.

3.2 S-Registers

3.2.1 What are S-Registers?

S-Registers are a standard means of configuring and programming Hayes compatible modems. Any modem, or modem like device typically supports some range of S-Registers. The LMU does not support any of the more standard lower S-Registers (such as S-Register 0, which is typically used as the number of rings to wait before answering an incoming call). The LMU's S-Registers begin at S120.

S-Registers are accessed through Parameter ID 1024. S-Registers, however, differ from other Parameters in two ways: first, their Values tend not to change once the LMU is fully configured. For instance, S-Register 120 is used to select what type of wireless modem the LMU is using. The other difference is they have an alternate AT Command that can be used to set and query their values. The commands are:

Set:

```
ATS<n>=<value>
```

Query:

```
ATS<n>?
```

Query Response:

```
<value>
OK
```

S-Registers programmed via this command cannot be masked. To do masking, the Parameter command described above must be used. Masking is described below.

There are currently 51 S-Registers and can range in value from 0 – 255. The available S-Registers and their settings are listed in Appendix B.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

S-Registers start at S-120 and end at S-171. For the Parameter commands (or messages) this corresponds to an Index range of 0 to 51. That is, the Index of an S-Register is the S-Register number minus 120.

3.3 Parameter Masking

3.3.1 What is Parameter Masking?

Parameter masking is a means of programming select parts of a Parameter's Value. This only applies to Parameter Values that are bit mapped. It is important to note that ALL S-registers must be masked when they are programmed via the Parameter AT Command. When using the ATS<n> command a mask value of 255 (0xFF) is automatically used. PULS™ also assumes a full mask for any bit mapped value it changes.

3.3.2 What is a bit mapped parameter values?

Bit mapped Parameter Values are ones where each bit controls a different setting within the LMU. That is, each bit tends to turn on or off a particular feature (say the TAIP interface) depending if the bit is set or cleared. Bit mapping of values is most common in S-Registers, though there are some other Parameters that support it.

3.3.3 How is a mask used?

A Mask allows a programmer to select which bits of a Value to change. That is, if bit 0 in the mask is set, then the value of bit 0 can be changed. The mask value has the same range as the Value. That is a 1 byte Value (range of 0-255) will have a 1 byte mask (also ranging from 0-255).

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

4 Working with Inputs, Outputs and Power

4.1 I/O Introduction

The CalAmp LMU products offer a variety of inputs and outputs to enable a wide variety of vehicle and asset tracking applications. For a complete description of what types of inputs and outputs are supported by a given device, please refer to its installation guide.

4.2 Input Types

The LMU products offer the following input types. Please note that not all inputs are supported by all products.

4.2.1 Digital Inputs

Digital inputs are meant to detect on/off behaviors such as ignition on/off or door opened/closed.

The LMU's digital inputs are protected from typical vehicle transients and can be directly connected to most vehicle level logical inputs from 6 volts up to vehicle power. Their input impedance is approximately 10 kΩ.

The Ignition input is pulled to ground through a 10kΩ resistance, where the other inputs can be configured to be biased high or low. For those biased high, the input is pulled to the supply voltage through a 10 kΩ resistor. For those biased low, they are pulled to ground through a 10 kΩ resistor. The diagrams below show some typical connections to the inputs in both a high- and low-biased configuration:

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

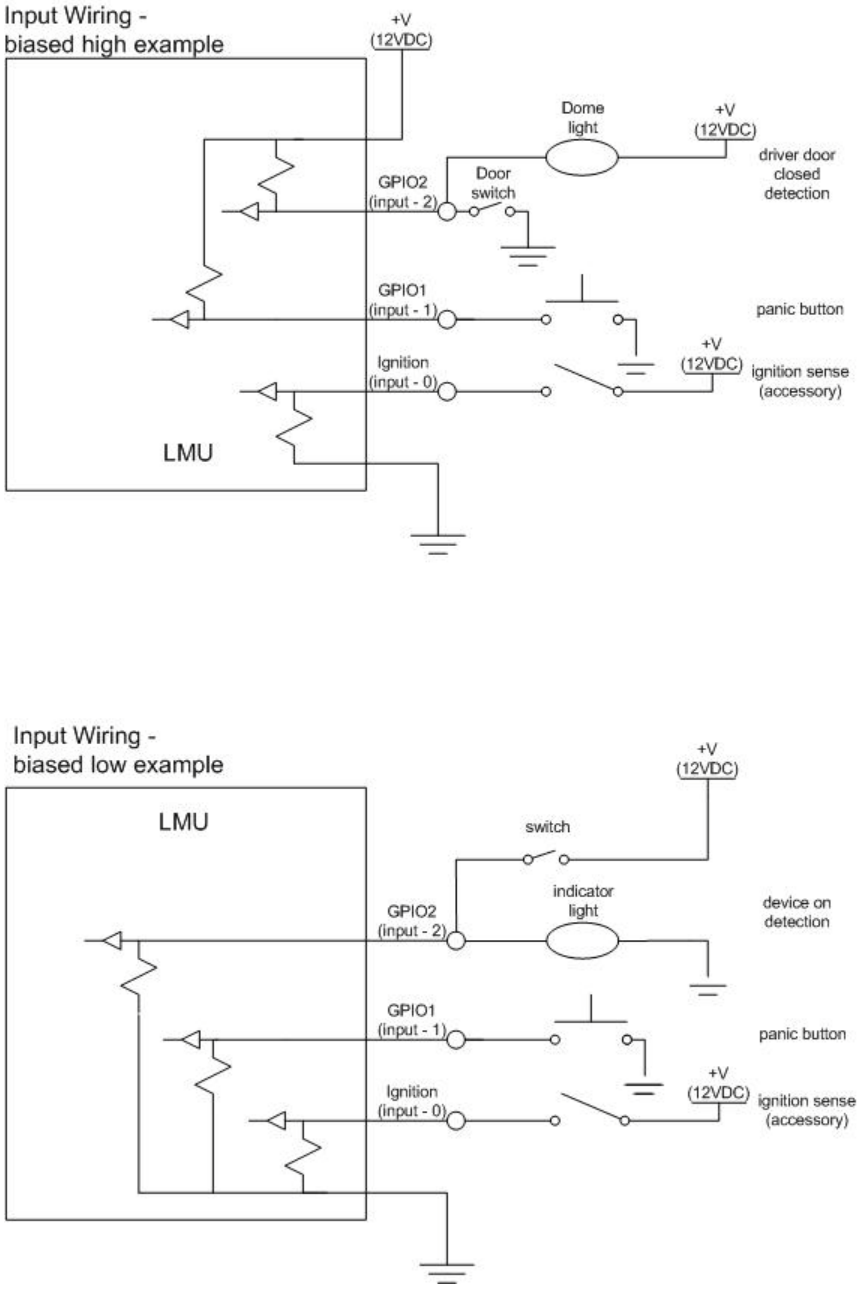


Figure 1 - Sample Digital Input Wiring

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

4.2.1.1 Changing the Input Bias

For some LMU products, the input Bias can be controlled by S-Register 158 (or Parameter 1024, Index 38). Each bit of this register is assigned to a specific input. If the associated bit is set, then the input is biased high, if the bit is cleared, then the input is biased low. The input to bit mapping is as follows:

Bit	Input	S-Register Mask
0	Not Used	
1	Input 1	2
2	Input 2	4
3	Input 3	8
4	Input 4	16
5	Input 5	32
6	Input 6	64
7	Input 7	128

For example, to bias inputs 1, 3, 5 and 7 high and bias 2, 4 and 6 low, you would use the following 7 commands:

```
AT$APP PARAM 1024,38,2,2
AT$APP PARAM 1024,38,4,0
AT$APP PARAM 1024,38,8,8
AT$APP PARAM 1024,38,16,0
AT$APP PARAM 1024,38,32,32
AT$APP PARAM 1024,38,64,0
AT$APP PARAM 1024,38,128,128
```

Alternatively you could have used a single command of:

```
ATS158=170     (i.e. 128+32+8+2)
```

4.2.2 Motion Sensor Input

Some of the LMU products support an internal motion sensor as one of the discreet inputs. In this case, the LMU detects motion when the input is in the High state. If the LMU does not detect motion, then the input will be in the Low state. The sensitivity of the motion sensor input is controlled by S-Registers 175 and 176.

4.2.3 Power State Input

Some of the LMU products can detect if they are using external power or if they are using their internal back-up battery. If they are using external power, this input will be in the Low state. If they have switched to the internal battery, then the input will register in the High state.

4.2.4 Battery Voltage Critical Input

The LMU-1100 and LMU-1200 have a built in low battery threshold of 3500mV, which is tied to a discreet input. If the battery level is above the threshold, then the input is in the Low state. If the battery level is below the threshold, the input will be in the High state.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

4.2.5 High Temperature Input

The LMU-1100 and LMU-1200 have a built in high temperature threshold of 60 °C. If the internal temperature of the LMU is above this value, then the input will be in the High state. If the LMU's temperature is below this value, then the input will be in the Low state.

4.2.6 The 1 Bit Bus

The 1-Bit-Bus allows the LMU-4100™ and LMU-2500™ to be connected to a variety of 1-Wire® Devices. The LMU-4100™ supports the iButton Driver ID products and the LMU-2500 supports the iButton Driver ID and Temperature Sensor products.

To connect an iButton DS9202 Probe to the LMU you would connect the Black wire to Ground (Pin 16 on the LMU-2500™and Pin 5 on the LMU-4100) and connect the Grey wire to the 1-Bit Bus input (Pin 17 on the LMU-2500™ and Pin 7 on the LMU-4100™) as shown below.

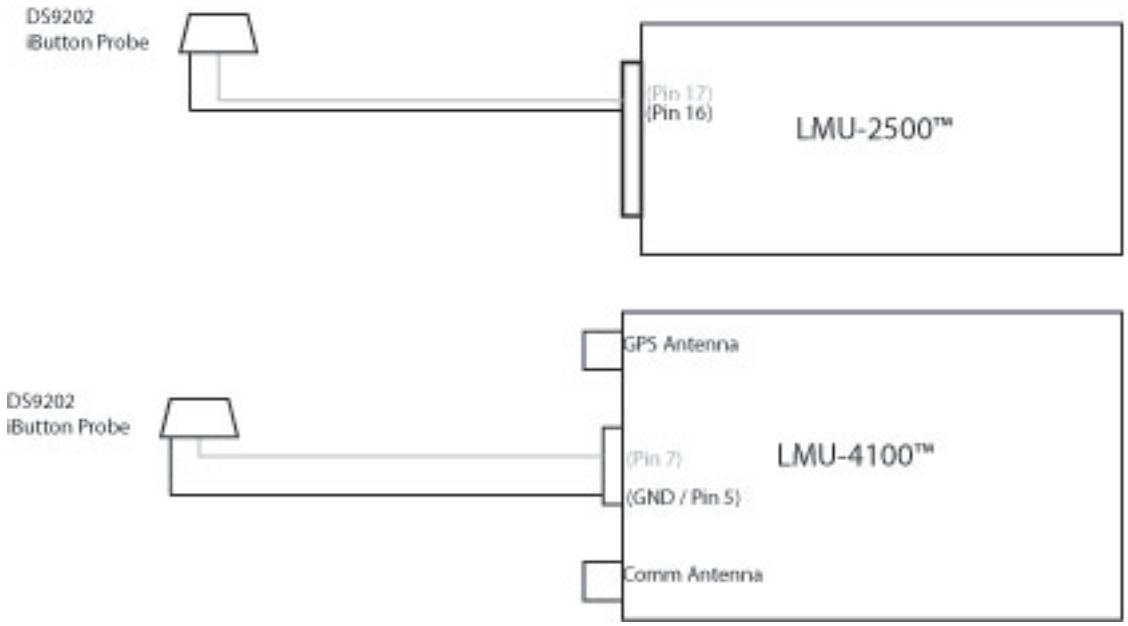


Figure 2 - Sample 1 Bit Bus Wiring

On the LMU-4100™, the 1-Bit Bus interface must be enabled by setting Bit 0 of S-Register 171.

Enable 1-Bit Bus Input/ Disable Output 0:

```
AT$APP PARAM 1024,51,1,1
```

Disable 1-Bit Bus Input / Enable Output 0

```
AT$APP PARAM 1024,51,1,0
```

On the LMU-2500™, you must select which device the LMU is using (i.e. iButton Driver ID tag or Temperature Sensor) on the 1-Bit Bus interface using Bit 6 of S-Register 171. The temperature sensor is enabled when Bit 6 is set and the ID tag is enabled when Bit 6 is cleared.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Enable Temperature Sensors:

```
AT$APP PARAM 1024,51,64,64
```

Enable ID Tag

```
AT$APP PARAM 1024,51,64,0
```

The LMU-2500™ can work with up to eight (reference 0-7) Maxim DS28EA00 1-wire temperature sensors in a chain configuration interconnected by a 3-wire bus. Upon boot-up, the LMU executes a discovery procedure to detect the number of connected DS28EA00 devices. The LMU assigns each sensor a reference number starting with zero (0) for the sensor closest to the LMU in the sensor chain and incrementing for each sensor down the chain up to seven (7). During operation, the LMU sequentially polls each sensor for its temperature reading; one sensor every 10 seconds. If all eight sensors are deployed, each sensor will be polled every 80 seconds. A poll involves commanding the sensor to perform the temperature conversion and 1-sec later reading the results of the conversion

4.2.7 Analog to Digital Inputs

The LMU's Analog to Digital (ADC) Inputs are used to convert an analog signal into a discrete voltage value. The meaning of the discrete voltage value will depend on the type of device being used.

All of the LMU's Analog to Digital inputs store values with a 1mV lsb. For example, if the Analog to Digital Input reads a 12000, it means the input signal was measured as 12V.

4.2.7.1 Voltage Monitors

The Voltage Monitor ADCs are generally used to keep track of the LMU's supply voltage. The ADCs are read with a 1mV lsb. For example, a typical vehicle power supply reads as 13.8V while in operation. The corresponding voltage monitor ADC (typically ADC 0) would read as 13800mV.

4.2.7.2 GPS Antenna

The GPS Antenna ADC on the LMU-2500 measures the voltage at the GPS Antenna to determine if a short or open circuit condition is present. The voltage reported is in mV and, in normal situations, should be approximate 3000mV (i.e. 3VDC).

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

4.3 Output Types

4.3.1 Relay Outputs

The LMU's outputs are designed to drive external relays. These outputs provide a high-current, open-collector driver that can sink up to 150 mA each. These drivers may be used to drive external relays that can then control vehicle functions such as door locks, fuel shut-off valves, sirens and lights. If additional current is required to drive the relays, external circuitry can be added to source the current. This diagram shows a typical relay connection to one of the LMU's outputs.

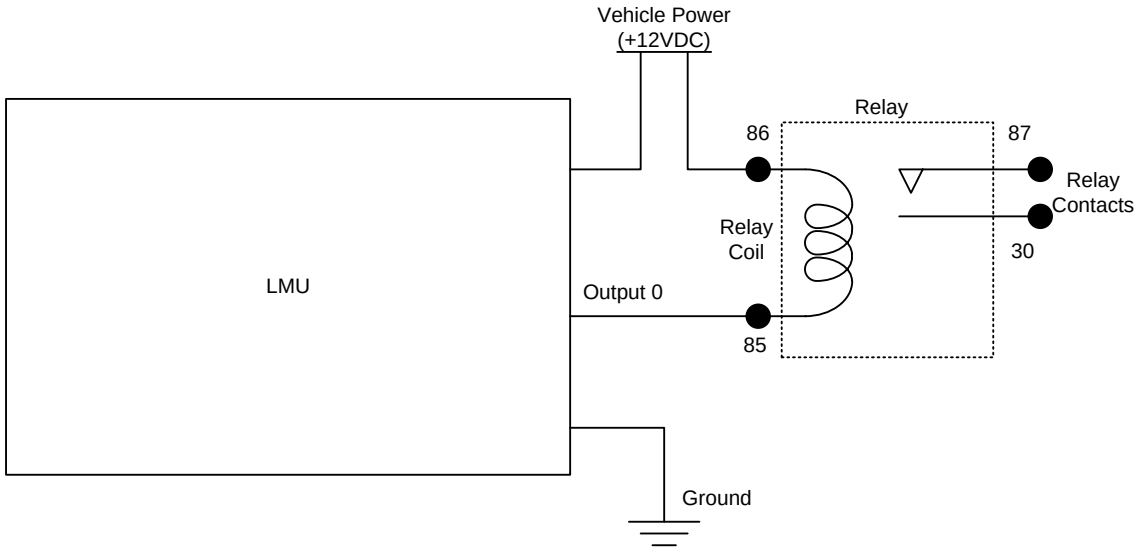


Figure 3 - Sample Relay Output Wiring

4.3.1.1 LMU-1000™ vehicle disable feature

To use the LMU-1000™'s vehicle disable feature, the ignition wire on the vehicle going between the starter relay and the ignition key switch should be cut. The two cut ends should be connected to the LMU-1000™ Relay Contact wires (blue/pin 2 and green pin 3). It doesn't matter which of the two cuts ends connects to which Relay Contact wire.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

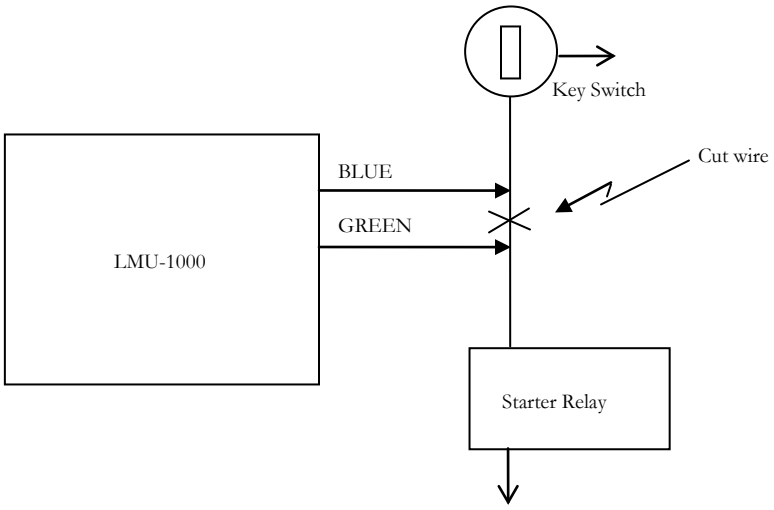


Figure 4 - LMU-1000™ Vehicle Disable Feature

Using the above set-up a vehicle can be enabled or disabled by clearing (enabled) or setting (disabled) output 0 via PEG Scripts, Real-Time PEG Actions or SMS messages.

4.3.2 External vs. Internal Power Switch

This output allows the LMU to switch between power sources when certain conditions are met (e.g. low power on the currently selected supply). If this output is set then the LMU will use its internal battery as its power supply. If this output is cleared, the LMU will use the external power supply.
By default, this output is cleared so the LMU will operate off external power.

4.3.3 Enable / Disable Battery Charging

This output allows the LMU to enable or disable the charging of its internal battery. If this output is set then the LMU will stop charging the internal battery. If this output is cleared the LMU will charge the internal battery.

By default, this output is cleared (i.e. battery charging enabled)

4.3.4 LED Outputs

On the LMU-1000™ the LED outputs mirror the behavior of the Comm and GPS Status LEDs. These allow an installer to remote the LEDs from the LMU-1000™ so they can be observed to verify an install.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

4.4 Selecting the GPIO Function

The input or output functionality of the GPIO pins is controlled by S-Register 159. Like the input bias controls, each bit is associated with a different GPIO. If the bit is set, then the GPIO will act as an output. If the bit is cleared, the GPIO will act as an input. The following bit mappings are available:

Bit	Input	S-Register Mask
0	GPIO 1	1
1	GPIO 2	2

For example to set GPIO 1 as an output and GPIO 2 as an input you would use:

```
AT$APP PARAM 1024,39,1,1
AT$APP PARAM 1024,39,2,0
```

Or you could use the single command of

```
ATS157 = 1
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

4.5 Working with Sleep Mode

4.5.1 Configuring the Input Wake-Up Monitor

The LMU's digital inputs have an additional feature besides simple On/Off detection which is to wake the LMU out of its sleep mode. The LMU is capable of filtering which input(s) can wake it from sleep based on Parameter 1029. Like S-Registers 157 and 158, each bit of Parameter 1029 is associated with a specific input. If the bit associated with that input is set, then the LMU will wake up on any high to low or low to high transition of that input. If the bit is cleared, the LMU will ignore any transitions for that input while it is sleeping.

A host device can also be used to wake the LMU from sleep via a wired serial connection using the Serial Cable, ioPOD or TetheredLocator adapters. The LMU must also be set NOT to power down its expansion port while sleeping. The LMU cannot be woken using the Bluetooth Adapter, nor can it be woken remotely.

The bit mappings for the Wake-Up Monitor are as follows:

Input	Bit	S-Register Mask
Ignition/Input 0	0	
Input 1	1	2
Input 2	2	4
Input 3	3	8
Input 4	4	16
Input 5	5	32
Input 6	6	64
Input 7	7	128

How the LMU enters sleep and how to monitor for wake up events is discussed in the PEG Programming Guide. Please refer to that document for details.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

4.5.2 Keeping the Expansion Port powered during sleep

The expansion port is the 16 pin connection on the back of the LMU where peripheral devices are plugged in. This port can actually remain powered while the LMU is sleeping. This would be done to allow any of the following:

- Keep Inputs and Outputs on the ioPOD in the High/Low or Set/Cleared states
- Allow the LMU to wake up on inputs connected to the ioPOD
- Allow the LMU to wake up based on host port activity

The power of the expansion port is controlled by bit 6 of S-Register 140. If this bit is set, then the expansion port remains powered while the LMU is sleeping. If this bit is cleared, the expansion port will be powered down when the LMU goes to sleep.
To keep the port powered on, you would use:

```
AT$APP PARAM 1024,20,64,64
```

To power it off during sleep you would use:

```
AT$APP PARAM 1024,20,64,0
```

Keep in mind that leaving the expansion port powered will increase the current draw of the LMU during sleep.

4.5.3 Keeping the Modem On during sleep

In some installations it may be desirable to be able to wake the LMU from sleep remotely. The LMU can support this by being configured to leave its radio on while sleeping.

To enable this feature you need to set Bit 2 of S-Register 171.

Enable Radio-On Sleep Mode

```
AT$APP PARAM 1024,51,2,2
```

Disable Radio-On Sleep Mode

```
AT$APP PARAM 1024,51,2,0
```

The LMU will wake when it receives any SMS message.
Be advised that the LMU will draw noticeably more power using this sleep mode.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

4.6 Working with the Status LEDs

By default, the Status LEDs work as described in the Install Guides, however, it is possible to override the default behaviors on the LMU-2500 and LMU-4100. Specifically, the Comm LED can be over-ridden to report Input Status for inputs 0-4 and the GPS LED can be over-ridden to provide satellite information.

4.6.1 Input State and Satellite Count Mode

In this mode, the Comm LED (Orange) will alternate between Comm Status and Input Status every 5s. The Comm Status behavior is described in the Install Guides. When reporting the Input states, it will blink with a single pulse when the input is low and two pulses when the input is high. After 500mS it reports the next input. The inputs are reported sequentially starting with Input 0 and finishing with Input 4. For example, if Comm was acquired, ignition (i.e. input 0) was on and all other inputs were low, you would see the following pattern:

Figure 5 - Alternate Comm LED Blink Pattern

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

For the GPS LED (Yellow) the GPS LED will indicate OFF (LED off), ON (slow blink) and TIME-SYNC (fast blink) as it always has. When the GPS is acquired, it reports the number of satellites being tracked by going on for 500mS, off for 500mS and then for each satellite being tracked, on for 125mS and off for 125 mS. After 5-sec, the pattern repeats. :For example, an LMU tracking 6 satellites would have a blink pattern similar to the following:

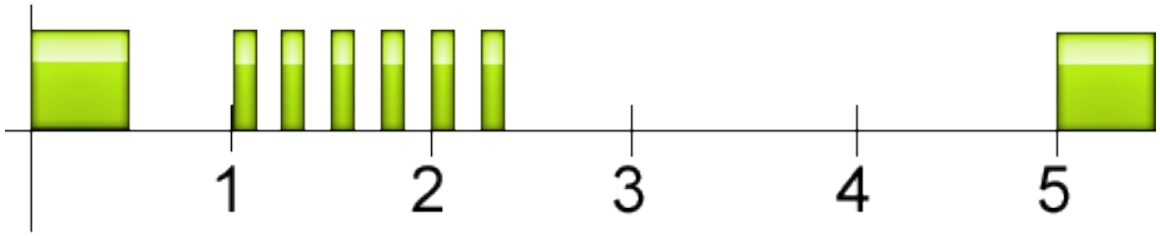


Figure 6 - Alternate GPS LED Blink Pattern

This mode is enabled by setting bit 3 of S-Register 171.

```
AT$APP PARAM 1024,51,8,8
```

To return the LEDs to their normal behavior, you would use:

```
AT$APP PARAM 1024,51,8,0
```

4.6.2 Alternate LED Blink Code

This mode also reports input status along with Comm and GPS Status.

The GPS LED will be off if the Ignition is off or if the LMU does not have a GPS fix. Otherwise, the GPS LED will report the number of satellites by blinking 'n' times after a single long blink. (i.e. similar to the pattern described above).

The COMM LED behavior is a little more complicated.
When the Ignition is off, the COMM LED will blink at a 1Hz rate (1 blink per second).
When the Ignition is on but the LMU does not have Comm and no other inputs are 'active', the COMM LED will blink at a 4Hz rate (1 blink every ¼ of a second).
If the Ignition is on with no other inputs 'active' and the LMU does have Comm, the COMM LED will be solid.
If the Ignition is on and other inputs are 'active', the COMM LED will blink the number of time corresponding to the first 'active' Input's designation followed by a pause and then the number of times corresponding to the next 'active' Input's designation.

An 'active' Input is one whose state does not match the corresponding bias setting in S-158.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

For example, let us assume that all inputs are biased low. If Ignition is On, and Inputs 2 and 4 are high then the COMM LED will blink twice, followed by a pause, followed by 4 more blinks.

This mode is enabled by setting both Bits 3 and 5 of S-Register 171.
To enable this mode, you would use:

```
AT$APP PARAM 1024,51,40,40
```

To return the LEDs to their normal behavior, you would use:

```
AT$APP PARAM 1024,51,40,0
```

4.6.3 Disabling the Status LEDs

In some installations it may be desirable to disable the status LEDs, for instance when the installation is covert and drivers/end users should not be able to easily locate the LMU. Turning the status LEDs off is controlled by bit 3 of S-Register 140. If this bit is set, then the Comm and GPS LEDs are disabled and turned off. If this bit is cleared, then the Comm and GPS LEDs will behave as normal.

To disable the LEDs you would use:

```
AT$APP PARAM 1024,20,8,8
```

To re-enable them, you would use:

```
AT$APP PARAM 1024,20,8,0
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

4.7 Restoring values through a power cycle

The LMU is capable of storing some of its values to non-volatile memory so that they can be restored after a power cycle. The following values may be stored:

- The values of all 16 Accumulators
- The states of all 16 PEG Flags
- The state (inside or outside) of all 32 PEG Zones
- Last known GPS position
- The current value of the PEG State variable (see PEG Programming Guide for details)

These values can optionally be saved at two points

- Before a soft reset (i.e. AT$APP QUIT or the Application Restart PEG Action)
- On ignition off

This feature is collectively known as an Environment Restore and is controlled by S-Register 127. Bits 0-3 control which values are saved where each bit is associated to a specific value. If the bit is set, the associated value is saved. If it is cleared, the associated value is not saved. The bit-mappings for bits 0-3 are as follows:

- Bit 0 = The values of all 16 Accumulators
- Bit 1 = The states of all 16 PEG flags
- Bit 2 = The state (inside or outside) of all 32 PEG Zones
- Bit 3 = Last known GPS position

Bits 6 and 7 of S-Register 127 control when these values are saved. If bit 6 is set, then the values are saved on a soft reset. If bit 7 is set, then the values are saved on an ignition off.

For example to save all four values on just ignition off, you would use the following commands:

Save Accumulators:

```
AT$APP PARAM 1024,7,1,1
```

Save PEG flags:

```
AT$APP PARAM 1024,7,2,2
```

Save PEG Zones:

```
AT$APP PARAM 1024,7,4,4
```

Save the last known GPS position:

```
AT$APP PARAM 1024,7,8,8
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Do no save on a soft reset:

```
AT$APP PARAM 1024,7,64,0
```

Save on ignition off

```
AT$APP PARAM 1024,7,128,128
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

5 Working with External Serial Devices

While all of the LMU products have a host port to allow users to issue AT Commands to configure, debug and control the device, only the LMU-4100 supports external serial devices as a peripheral. The one exception is that the LMU-2500 does support the output of NMEA sentences on its host port.

The CalAmp LMU-4100™ and LMU-2500™ supports three external serial ports for use with other devices, though only two can be available at the same time. The serial ports are:

- The Host Port (LMU-4100™ and LMU-2500™)
- The Modem Port (LMU-4100™ only)
- The Aux Port(LMU-4100™ only)

To access these ports you would need a specific peripheral. The mapping of serial ports to peripherals is as follows:

Port	Peripheral
Host Port	Serial Adapter
	TetheredLocator Adapter
	ioPOD Adapter
	Bluetooth Adapter
Modem Port	TetheredLocator Adapter
Aux Port	ioPOD Adapter

The following sections describe how each of these ports can be used. Using serial ports via the Bluetooth Adapter is described in its own section.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

5.1 Using the Host Port

The Host Port of the LMU-4100™ and LMU-2500™ can be accessed in one of two ways, either in Host mode, which is meant for use with laptops, and PDAs or MDT mode, which is meant for use with serial mobile data terminals, bar-code readers, magnetic-card readers and other 'dumb' serial devices. In Host mode, a host device can issue AT Commands, receive NMEA data or establish a Dial-Up Networking session. In MDT[1] mode, the LMU-4100 will act as a message pass-thru for the dumb serial device. That is, it will send any messages it receives from the serial device to the backend system and vice-versa.

5.1.1 Host Mode - AT Command Setup

To issue AT Commands to the LMU-4100™ or LMU-2500™, you would need some measure of terminal program such as HyperTerminal. Instructions on how to set HyperTerminal up for use with the LMU™ can be found in the Appendix D of this document.

The default settings for the Host port are:

- 115200 BAUD
- 8 Data Bits
- No Parity
- 1 Stop Bit

The only setting that can be changed is the BAUD rate. This can be done with one of two AT Commands:

```
AT+IPR=<baud rate>
ATS148=<value>
```

The Host port BAUD rate will change instantly after the AT+IPR command is issued. The LMU™ must be reset for the BAUD rate to change after using the S148 command. Both changes are non-volatile and thus the BAUD rate will remain unchanged during subsequent power cycles. The LMU™ supports the following BAUD rates:

BAUD Rate	S148 Value
4800	4
9600	5
19200	7
38400	9
57600	10
115200	12
Default	255

[1] MDT stands for Mobile Data Terminal. This mode is also known as Generic Serial Device mode or GSD. The documentation uses both notations.

Copyright ©CalAmp DataCom Inc 2009

DO NOT use values that are not on this list as it may cause unexpected behaviors within the LMU.

Changing the BAUD rate setting will have an effect on the NMEA output and the Dial-Up Networking functions of the Host Port.

5.1.2 Host Mode – NMEA Output

NMEA messages are generally used by in-vehicle navigation applications to plot the current position of the vehicle and compute real-time driving directions. The LMU-4100™ or LMU-2500™ can output several NMEA sentences over its Host Port to support these applications. The available sentences are:

- GGA (GPS Fix Data)
- GLL (Geographic Position, Latitude / Longitude)
- GSA (GNSS[2] DOP and Active Satellites)
- GSV (GNSS Satellites in View)
- RMC (Recommended Minimum Specific GNSS Data)
- VTG (Course Over Ground and Ground Speed)
- ZDA (Date and Time)

Please refer to your application's documentation as to which messages it needs to operate properly.

S-Register 128 is used to control which messages are sent to the serial port. Each message is associated with a specific bit of this register. If the bit is set, then the message will be sent to the host port. If the bit is cleared the message will not be sent. The bit mapping of S-128 is as follows:

- Bit 0 – Enable/Disable GGA Message
- Bit 1 – Enable/Disable GLL Message
- Bit 2 – Enable/Disable GSA Message
- Bit 3 – Enable/Disable GSV Message
- Bit 4 – Enable/Disable RMC Message
- Bit 5 – Enable/Disable VTG Message
- Bit 6 – Enable/Disable ZDA Message

For example, to enable the GGA and RMC messages you could use:

```
ATS128=17
```

Alternatively you could use two Parameter commands:

Turn on GGA

[2] Global Navigation Satellite System, which could refer to GPS, GLONASS, Galileo, etc…

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

```
AT$APP PARAM 1024,8,1,1
```

Turn on RMC

```
AT$APP PARAM 1024,8,16,16
```

5.1.3 Host Mode – Dial-Up Networking

The LMU-4100's™ Host Port can be used by a laptop or PDA to establish a Dial-Up Networking session. This is to allow the laptop or PDA access to the Internet to enable such applications as email and web-browsing.

There are two basic steps to accomplish this:

1. Install a modem driver
2. Create the Dial-Up Networking session

The details on each of these steps are described in the Adding a Modem Driver and Creating a Dial-Up Networking Session Appendixes of this document.

Depending on the wireless networking technology employed by the LMU-4100, there are several other steps you should take to ensure uninterrupted operation.

5.1.3.1 Disable Connection Monitoring

The Connection Monitor is used by the LMU-4100™ to ensure that the data session with the wireless modem is still valid. In some cases, this may reduce the stability of Dial-Up Networking session. The connection monitor is controlled by two S-Registers, 152 and 154. S-Register 152 should be set to 0 and for S-Register 154 bit 2 should be cleared and bit 3 should be set. The two commands you would use to accomplish this are:

```
ATS152=0
AT$APP PARAM 1024,34,12,8
```
[3]

Please note that the connection monitor is described in detail later in this document.

5.1.3.2 Disable Network Status Queries

For the Kyocera based CDMA LMU-4100™ it is advisable to disable any KMIP[4] polling, as any missed KMIP messages may cause the LMU to reset the modem. A modem reset would then cause the Dial-Up Networking session to be torn down. KMIP polling is controlled by S-Register 153. To disable KMIP polling you would use:

```
ATS153=0
```

[3] One question that may arise is why not use ATS154=8 instead of the PARAM command. The basic answer is so that we do not interfere or change any settings we do not absolutely need to. We will make heavy use of parameter bit masking through-out this document for that reason.

[4] KMIP is a protocol the LMU-4100 uses to talk to the Kyocera M200 CDMA modem. It is used to pull modem information such as carrier id and RSSI.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

To re-enable KMIP polling you would use:

```
ATS153=10
```

KMIP Polling is described in detail later in this document.

5.1.3.3 Bypass Mode

Bypass mode, in reference to Dial-Up Networking applies to just the CDMA LMU-4100™. In this mode, the LMU switches itself out of the data path and allows the host laptop or PDA to establish the Dial-Up Networking session directly with the CDMA modem. This occurs automatically when the Host Port BAUD rate and the Modem Port BAUD rate are set to the same value. The Host Port BAUD rate is controlled by S-148 and the Modem Port BAUD rate is controlled by S-146.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

5.1.4 MDT Mode

MDT Mode allows a dumb serial device to pass messages through the LMU-4100™ or the LMU-2500™ to the back-end system using LM Direct User Messages. The backend system may also send a User Message to the LMU, the contents of which should be forwarded to the serial device.
MDT mode can be enabled on either the Serial Adapter peripheral or on the ioPOD peripheral by means of a jumper.

The Host Port's MDT mode settings are controlled by S-Registers 130 thru 138 and S-Register 141.

5.1.4.1 MDT Sub-Modes – LMU-4100™

The Host Port's MDT mode supports two sub-modes, Generic Serial Device Mode and Long Message Mode.

In Generic Serial Device mode, the LMU-4100™ will accept only single messages from the generic serial device that are 804 bytes in length or less. Any excess data received will be truncated. The LMU will package all 804 bytes in a single user message.

In Long Message Mode, the LMU-4100™ will break-up messages longer than 804 into multiple User Messages. Each User Message will contain up to 804 bytes of data. It is up to the receiving application (i.e. the backend) to re-assemble the original message from each of the user messages.

In either mode, the backend system can only send messages to the LMU of 848 bytes or less.

Which mode is in use is controlled by S-Register 130. A value of 1 enables Generic-Serial Device Mode and a value of 2 enables Long Message Mode. All other values are undefined and should not be used. That is, to enable Generic Serial Device mode you would use:

```
ATS130=1
```

To enable long message mode you would use:

```
ATS130=2
```

5.1.4.2 MDT Modes – LMU-2500™

The LMU-2500™ only supports the Generic Serial Device mode. This mode is enabled by setting S-Register 130 to 129. In this mode the LMU-2500™ will be in Host Port mode for the first 30s after power up. After that, the LMU-2500™ switches to Generic Serial Device mode. After a wake-up, the LMU-2500™ immediately enters Generic Serial Device mode.

To enable Generic Serial Device mode on the LMU-2500™, you would use:

```
ATS130=129
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

To disable this mode, you would use:

```
ATS130=0
```

5.1.4.3 MDT Mode – Serial Port settings

The MDT Mode serial port settings are independent from the Host Port Host Mode settings. The MDT mode settings are controlled by 2 S-Registers, 131 and 132. These register control the BAUD Rate, Data Bits, Parity and Stop Bits settings for MDT mode. These changes do not affect the settings of S-148 or the +IPR command (i.e. the host port baud rate).

The MDT mode BAUD Rate is controlled by S-Register 131 and supports the following data rates:

- 4800 BAUD (`ATS131=4`)
- 9600 BAUD (`ATS131=5`)
- 19200 BAUD (`ATS131=7`)
- 38400 BAUD (`ATS131=9`)
- 57600 BAUD (`ATS131=10`)
- 115200 BAUD (`ATS131=12`)

To change the Data Bits, Parity and Stop Bit settings, you would use S-Register 132. The follow table describes each of the available combinations:

Data Bits	Parity	Stop Bits	S-132 Setting
8	None	2	7
8	None	1	3
8	Even	2	31
8	Even	1	27
8	Odd	2	15
8	Odd	1	11
7	None	2	6
7	None	1	4
7	Even	2	30
7	Even	1	26
7	Odd	2	14
7	Odd	1	10
6	None	2	5
6	None	1	1
6	Even	2	29
6	Even	1	25
6	Odd	2	13
6	Odd	1	9
5	None	2	4
5	None	1	0
5	Even	2	28
5	Even	1	24
5	Odd	2	12
5	Odd	1	8

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

5.1.4.4 MDT Mode – Termination Character

The LMU-4100™ and LMU-2500™ can optionally detect a 'Termination Character' in the data sent from the serial device over the MDT port. This character is meant to denote the end of the message and that LMU should send the contents to the back-end system.

The Termination Character is meant for use when the serial device is sending ASCII encoded text. When using serial devices that produce binary messages, it is best not to use a Termination Character.

Two S-Registers control the Termination Character, one to enable it (S-133) and one to define it (S-134).

To enable use of a Termination Character, you would need to set bit 2 of S-133. This is done as follows:

```
AT$APP PARAM 1024,13,4,4
```

To disable the Termination Character, you would clear bit 2 using:

```
AT$APP PARAM 1024,13,4,0
```

The Termination Character to use is defined in S-134. S-134 is set to the decimal ASCII value of the desired character. For instance, to use a Carriage Return, you would set S-134 to 13. That is:

```
ATS134=13
```

An ASCII chart can be found in Appendix C of this document.

5.1.4.5 MDT Mode – Message Termination Length

As an alternative to using a Termination Character, the LMU can be configured to send User Messages based on the amount of data it receives from the serial device. That is, the LMU will buffer a certain number of bytes and once it reaches the limit it will package the entire buffer into a User Message and send it to the back-end system. The size limit of the buffer is defined by S-Register 135. The value of S-135 is scaled in 4 byte increments up to a maximum 804 bytes. The range of S-135 is therefore 1-201. For instance, to package 200 byte User Messages you would use:

```
ATS135=50
```

By setting the value of S-135 to 0 disables the termination length feature.

5.1.4.6 MDT Mode – Message Termination Timeout

The last option to define when to build a User Message is the Termination Timeout. In this case, the LMU will collect data from the serial device for a specific period of time. When that time has elapsed, the LMU will package the data into a User Message and send it to the

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

back-end system. Please note that the LMU will still obey its maximum buffer size (804 bytes) even if the Termination Length is undefined.

The Termination Timeout is controlled by S-Register 138 and ranges from 1 to 255ms. For instance, to set the timeout for 120ms you would use:

```
ATS138=120
```

Like the Termination Length, setting S-register 138 to 0 will disable the Termination Timeout feature.

5.1.4.7 MDT Mode – User Message ID

The User Message ID field serves two purposes for User Messages. First, the LMU will tag any inbound (LMU to server) User Messages with the defined Message ID. This will appear in the User Message ID field of the LM Direct packet. The second function is to act as a filter on any outbound (server to LMU) User Messages. If the outbound User Message does not have the same ID as the LMU, then the contents of the User Message will not be sent to the serial device. The Message Received PEG Trigger however, will work regardless of matching User Message IDs.

The Message ID can range from 0 to 255 and is defined in S-Register 136. For instance, to define a User Message ID of 4, you would use:

```
ATS136=4
```

This feature is always enabled, so it is very important to co-ordinate this setting with whoever is responsible for your LM-Direct implementation.

5.1.4.8 MDT Mode – Message Disposition

The message disposition defines how the LMU's log will handle the User Messages. There are six options:

- Attempt to send the User Message immediately. The message will be logged if the send fails or if the log is already active.
- Immediately log the User Message
- Immediately send the User Message using the Unacknowledged service and place a copy in the LMU's log. (i.e. Priority Message)
- Send the User Message using the Unacknowledged service (i.e. message is never logged)
- Route the User Message (contents only) to the SMS Destination Address
- Route the User Message (contents only) to the last phone number of an incoming SMS message

With the last two options the contents of any incoming SMS messages will be routed to the serial device.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

The message disposition is controlled by S-Register 137. The settings are as follows:

- 1 or 2 = Send Message, Log if Send Fails
- 3 = Log Message
- 4 = Priority Message
- 5 = Unacknowledged Message
- 7 = Route Incoming (Client to LMU) SMS messages to the host serial port. Route all User Messages to the SMS Destination Address
- 8 = Route Incoming (Client to LMU) SMS messages to the host serial port. Route all User Messages to the last phone number that sent the LMU a message

5.1.4.9 MDT Mode – Message Count Limit

The Message Count Limit is a means of controlling how much data is sent as User Messages. It was specifically designed for cases where the same message is repeated often by the serial device, for instance, a meter that provides a reading every 10s. The Count Limit allows the LMU to ignore a certain number of these messages before creating a User Message. That is, the LMU will ignore X-1 messages and create a User Message around the X message. X is defined by S-Register 141. The lower 7 bits of S-141 define the message count. Bit 7 defines the scaling. If bit 7 is set, the value in bits 0-6 is scaled by 100. This means that there are two supported ranges, 0 – 127 messages and 100 to 12700 messages. For example, to filter out 50 messages you would use:

```
ATS141 = 50
```

To filter out 500 messages you would use:

```
ATS141 = 133
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

5.2 Using the Aux Port

The Aux Port on the ioPOD can be used for one of two purposes, it can either be a source for NMEA messages, or it can act as an MDT port. The mode of the Aux Port is controlled by S-Register 160. If bit 0 of this register is cleared, then the port is setup for MDT mode. If bit 0 is set, then the port is set up for NMEA mode (bit 0 is set).

For MDT mode you would use:

```
AT$APP PARAM 1024,40,1,0
```

For NMEA mode you would use:

```
AT$APP PARAM 1024,40,1,1
```

5.2.1 NMEA Mode

The Aux port's NMEA mode supports two NMEA messages, the GGA message and RMC message. The GGA message is automatically enabled when NMEA mode is enabled. To turn on the RMC message, you would use bit 4 of S-160. To turn the RMC message on, you would set bit 4. That is:

```
AT$APP PARAM 1024,40,16,16
```

The RMC message is disabled by clearing bit 4.

```
AT$APP PARAM 1024,40,16,0
```

5.2.2 MDT Mode

The Aux port's MDT mode is identical to the MDT mode of the Host Port. That is, you may connect a serial device to the Aux port and be able to receive User Messages sent from the serial device at your back-end system. The available settings for the Aux Port are similar to those of the Host Port, so we only discuss the Aux Port's settings below.

5.2.2.1 MDT Mode – Serial Port settings

The Aux port's MDT mode serial settings are controlled by 2 S-Registers, 161 and 162. Using these registers, a user can change the BAUD Rate, Data Bits, Parity and Stop Bits settings for MDT mode.

The MDT mode BAUD Rate is controlled by S-Register 161 and supports the following data rates:

- 4800 BAUD (`ATS161=4`)
- 9600 BAUD (`ATS161=5`)
- 19200 BAUD (`ATS161=7`)
- 38400 BAUD (`ATS161=9`)
- 57600 BAUD (`ATS161=10`)

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

- 115200 BAUD (`ATS161=12`)

To change the Data Bits, Parity and Stop Bit settings, you would use S-Register 162. The follow table describes each of the available combinations:

Data Bits	Parity	Stop Bits	S-162 Setting
8	None	2	7
8	None	1	3
8	Even	2	31
8	Even	1	27
8	Odd	2	15
8	Odd	1	11
7	None	2	6
7	None	1	4
7	Even	2	30
7	Even	1	26
7	Odd	2	14
7	Odd	1	10
6	None	2	5
6	None	1	1
6	Even	2	29
6	Even	1	25
6	Odd	2	13
6	Odd	1	9
5	None	2	4
5	None	1	0
5	Even	2	28
5	Even	1	24
5	Odd	2	12
5	Odd	1	8

5.2.2.2 MDT Mode – Termination Character

Two S-Registers control the Termination Character for the Aux Port, one to enable it (S-163) and one to define it (S-164). To enable use of a Termination Character, you would need to set bit 2 of S-163. This is done as follows:

```
AT$APP PARAM 1024,43,4,4
```

To disable the Termination Character, you would clear bit 2 using:

```
AT$APP PARAM 1024,43,4,0
```

The Termination Character to use is defined in S-164. S-164 is set to the decimal ASCII value of the desired character. For instance, to use a Carriage Return, you would set S-164 to 13. That is:

```
ATS164=13
```

An ASCII chart can be found in Appendix C of this document.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

5.2.2.3 MDT Mode – Message Termination Length

The Message Termination Length for the Aux port is defined by S-Register 165.
The value of S-165 indicates how many bytes to make the message. The value may range from 1 to 201 giving a byte range of 4 to 804 bytes. For instance, to set a Message Termination Length of 200 bytes you would use:

```
ATS165=50
```

Setting the value of S-165 to 0 disables the Termination Length feature.

5.2.2.4 MDT Mode – Message Termination Timeout

The Termination Timeout for the Aux Port is controlled by S-Register 168 and ranges from 1 to 255ms. For instance, to set the timeout for 120ms you would use:

```
ATS168=120
```

Like the Termination Length, setting this S-Register to 0 will disable the Termination Timeout feature.

5.2.2.5 MDT Mode – User Message ID

The User Message ID field serves two purposes; first, the LMU will tag any inbound (LMU to server) User Messages with the defined Message ID. This will appear in the User Message ID field of the LM Direct packet. The second function is to act as a filter on any outbound (server to LMU) User Messages. If the outbound User Message does not have the same ID as the LMU, then the message will not be sent to the serial device. The Message Received PEG Trigger however, will work regardless of matching User Message ID.

The Aux Port's Message ID can range from 0 to 255 and is defined in S-Register 166. For instance, to define a User Message ID of 44, you would use
:

```
ATS166=44
```

This feature is always enabled, so it is very important to co-ordinate this setting with whoever is responsible for your LM-Direct implementation.

It is also important to note that the LM Direct packet must indicate which port (Host or Aux) the message should be sent to. Please refer to the LM Direct Reference Guide for details. In general, it is good practice not to use the same value for the User Message ID on the Host Port as is used on the Aux Port. At very least this will help the LM Direct server determine which port was the source of the User Message.

5.2.2.6 MDT Mode – Message Disposition

The Message Disposition defines how the LMU will deal with the User Message. There are four options:

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

- Attempt to send the User Message. If the message cannot be sent, or the log is already active, the User Message is logged.
- Immediately log the User Message
- Route the User Message (contents only) to the SMS Destination Address
- Route the User Message (contents only) to the last phone number of an incoming SMS message

With the last two options the contents of any incoming SMS messages will be routed to the serial device.

The Message Disposition is controlled by S-Register 167. The settings are as follows:

- 1 or 2 = Send Message, Log if Send Fails
- 3 = Log Message
- 7 = Route Incoming (Client to LMU) SMS messages to the Aux Serial Port. Route all User Messages to the SMS Destination Address
- 8 = Route Incoming (Client to LMU) SMS messages to the Aux Serial Port. Route all User Messages to the last phone number that sent the LMU a message

5.2.2.7 MDT Mode – Message Count Limit

The Message Count Limit for the Aux port is defined by S-169. Unlike the Host Port, the Aux Port limit does not offer a scaling option and therefore only ranges from 0-255 messages. For example, to send every 10th message received on the Aux Port, you would use:

```
ATS169=10
```

To send every 150th message, you would use:

```
ATS169=150
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

5.3 Using The Garmin NUVI or MacKenzie Labs DAD-A1214

The LMU-4100 also supports messaging for two specific serial devices, the Garmin NUVI and the MacKenzie Labs DAD-A1214. For which messages are supported for each device, please refer to the PEG Programming Guide.

Both the device selection and which port the device is connected to are dictated by S-Register 173. The lower 4 bits dictate the device and the upper 4 bits dictate the destination port. The bit mappings are as follows:

- Bits 5 and 7 – These bits define which serial port the canned message is sent to. The options are:
  - 0 = Host Port
  - 1 = Modem Port
  - 2 = Aux Port
  - 3-31 = Reserved
- Bits 0 and 4 – These bits define which device the LMU is connected to. The options are:
  - 1 = Mackenzie LABs DADS-A1214
  - 2 = Garmin NUVI
  - 0,3-31 = Reserved

For example, to use the DADS-A1214 on the Aux Port, you would use:

```
ATS173=65 (0x41)
```

To use the Garmin NUVI on the Host Port, you would use:

```
ATS173=2 (0x02)
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

5.4 Using the Modem Port

An external Modem Port is only available when using the TetheredLocator adapter. Otherwise, the Modem Port is assumed to be connected to the LMU's internal modem. Using the external Modem Port allows users to connect an LMU to an existing modem or phone via a serial connection. The LMU should then be able to use the phone or modem's Dial-Up Networking capabilities to establish a data session.

When working with an external modem, there are five settings you must keep in mind:

- The modem driver in use.
- The modem port's BAUD rate
- The packet dial string
- The network username
- The network password

5.4.1 Selecting a Modem Driver

The modem driver the LMU will use is defined by S-Register 120 or S-Register 150, depending on which Comm Profile is in use. Comm Profiles are discussed below. This register should only be changed when using the TetheredLocator adapter, or when directed by CalAmp personnel.

The available external modem drivers are:

- 128 – Generic 19200 BAUD, ATDT 0, No Status
- 131 – iDEN - Motorola iDEN devices, 38400 BAUD, ATD0, RALP Status
- 133 – GSM/GPRS – WaveCom, 57600 BAUD, ATDT*99***#1, WMUX Status
- 134 – GSM/GPRS – Generic, 57600 BAUD, ATDT *99***#1, no Status
- 136 – TAIP Modem – 9600 BAUD, TAIP string sent directly to modem Serial port
- 137 – No Modem
- 139 – CDMA - Kyocera M200, 57600 BAUD, ATD#777, KMIP Status
- 140 – CDMA – Generic- 57600 BAUD, ATD#777, No Status
- 141 – TDMA - Sony Ericsson DM25, 9600 BAUD, (SMS Only), no Status
- 142 – iDEN – Motorola iDEN devices, 57600 BAUD, ATDT 0, CMUX Status
- 143– GSM/GPRS – Siemens, 115200 BAUD, ATD*99***1#, PPP, Siemens
- 144 – Iridium Data modem

The available internal modem drivers are:

- 3 – iDEN LMU-4100 (TC990569)
- 11 – CDMA LMU-4100 (Kyocera M200)
- 14 – iDEN LMU (TC990599)
- 15 – GPRS LMU-4100
- 17 – CDMA LMU-4100 (WaveCom Q2438)
- 18 – GPRS LMU (Cinterion MC55)

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

The first value indicates what the S-120 setting should be. For example to use a generic CDMA modem driver you would use:

```
ATS120=140
```

If you are unsure of what driver you should use for your external device, pick the generic one (`ATS120 = 128`) as it can be adapted to most network technologies.

5.4.2 Configuring the Modem Port's BAUD Rate

Like the Host Port, the Modem Port only allows users to change the BAUD rate settings. The Data Bits are always set to 8, there is always 1 Stop Bit, and always no Parity. The BAUD rate is controlled by S-Register 146. The available settings are:

- 4=4800
- 5=9600
- 7=19200
- 9=38400 (Default iDEN)
- 10=57600
- 12= 115200 (Default GPRS & CDMA)
- 255 = use default

In general, you can usually set this S-Register to use the technology default value (i.e. `ATS146=255)` as the LMU will attempt to automatically detect and change the current BAUD rate of the external phone or modem.

5.4.3 Setting the dial string

The Dial String is effectively the phone number a host device, such as the LMU, would use to establish a Dial-Up Networking session with the external phone or modem. In most cases, the external phone or modem will use a technology specific value.

- CDMA 1xRTT Dial String = #777
- GPRS Dial String = *99***1#
- iDEN Dial String = 0

The Dial String is controlled by Parameter 2316. For example to use a CDMA dial string, you would enter the following AT Command:

```
AT$APP PARAM 2316,0,"#777"
```

One important thing to note for GPRS devices is that the LMU will not program the APN settings into the external phone or modem. It is assumed that the APN settings have been pre-configured by the provider of the phone or modem.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

5.4.4 Setting the network username and password

For some networks, the operator may require that a username and password be supplied before the device is allowed to establish a data session with the network. The LMU can be programmed to supply these values as part of the Dial-Up Networking negotiations. The username is controlled by Parameter 2314 and the password is contained in Parameter 2315. For instance, to set a username and password combination of 'dummy'/'dummy' you would use:

```
AT$APP PARAM 2314,0,"dummy"
AT$APP PARAM 2315,0,"dummy"
```

Be advised that some usernames and passwords can be case sensitive, that is 'Dummy' is a different username than 'dummy'. Be sure you enter the values as they were provided to you by your network operator otherwise the LMU might not be able to establish a data session.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

6 Using the CalAmp Bluetooth Adapter (BTA)

The LMU-4100™ supports Bluetooth functionality using the CalAmp Bluetooth Adapter (BTA) (Part Number TC1106-9). The LMU-4100™ can be configured to use the BTA as its Host port able to either initiate or accept the Bluetooth connection to the other device(s).

The Bluetooth adapter has three parameters associated with it.

- Parameter 2080 – **Bluetooth Name**:
  This Parameter contains a string which is compared to the remote device names during a scan. If this string is found within the name of a remote device the BTA will attempt to connect to that device. If this string is empty, all remote device names will be eligible for connection.
- Parameter 2081 – **Bluetooth PIN:**
  The PIN is effectively the password one Bluetooth device uses to access another. When the LMU-4100™ initiates the connection, this should be the PIN of the remote device. When the LMU-4100™ is accepting the connection, this is the value the connecting device should use.
- S-Register 170 – **BlueLocator Configuration Settings:**
  This is another bit mapped S-Register with the following controls:
  - **Mode Control (bits 0 and 1)**
    The BTA supports two modes, Off, and Host Port. A value of 0 is off, and a value of 1 sets the BTA up as a Host Port. 2 and 3 are not defined and should never be used.
  - **Discoverable (bit 2)**
    Discoverable means that the LMU-4100™ will be visible to other Bluetooth devices when they perform a scan. Setting bit 2 enables discovery, clearing it disables discovery.
  - **Initiator/Acceptor (bit 3)**
    This function controls if the LMU-4100™ will attempt the Bluetooth connection (Initiator) or if it will wait for a device to connect to it (Acceptor). If bit 3 is set, the LMU-4100™ will act as an initiator, if it is cleared, the LMU-4100 will act as an acceptor.
  - **Profile (bit 4)**
    The BTA supports two Bluetooth profiles, the Serial Port Profile or the Dial-Up Networking profile. This setting applies to both the host port and modem port modes.[5] If bit 4 is set, the LMU-4100™ will present the Dial Up Networking Profile, if it is cleared, the LMU-4100™ will present the Serial Port Profile.
  - **Security Mode (bit 5)**
    The BTA supports a high and low security mode. In the high security mode, the connecting device must supply the PIN every time it connects to the BTA. In low security mode, it is only provided on the initial connection.

[5] For older versions of the Bluetooth Adapter, this setting only applied when the BTA was acting as the modem port.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Setting bit 5 will place the BTA in low security mode, clearing it will use high security mode.

6.1 Using the BTA as the Host Port

When acting as a host port, the LMU-4100™ and newer BTA will actually present three ports:

- Port 1 which is used for NMEA output using a Serial Port Profile
- Port 2 which is used as the primary Serial Port Profile or Dial-Up Networking profile
- Port 3 which is used for AT Commands and Debug output.

Please note that for some host devices, all three of these ports may not be visible.

Older BTAs will present only a single port using the profile selected by Bit 4 of S170. Each of the above functions (NMEA, Dial-Up Networking and AT Commands/Debug) can be performed over this port, but only one can be handled at a time.

6.1.1 NMEA Output

The NMEA Output is separated from the other functions on Port 1 so each may be run simultaneously.

In this case, users must simply setup S128 to reflect the desired NMEA messages. For example, to export the NMEA RMC and GGA messages, users would use:

```
ATS128=5
```

Note that you do not need to worry about the BAUD rate or the profile in use. Port 1 (NMEA) always makes use of the Serial Port Profile and the BAUD rates are handled by Bluetooth.

When you pair to the BTA, be sure to select the NMEA port (or first serial port profile) to connect to this function.

6.1.2 AT Command and Debug Output

Like the NMEA feature, the AT Command and Debug output is separated from the other Bluetooth features on Port 3. This means that you can issue AT Command while the Bluetooth Adapter is providing NMEA data and while it is acting as a modem.

To setup, the LMU-4100™ to allow debug output, you will just need the following:

- BTA is used as a Host port (1)
- BTA needs to be discoverable (bit 2 = 1)
- BTA will act as an acceptor (bit 3 = 0)

```
ATS170=5
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Again, we do not need to worry about the profile or BAUD rate settings.

When you pair to the BTA, be sure to select the Debug port (or last serial port profile) to connect to this function. Please note that this function may not be available on all connecting devices.

6.1.3 Dial-Up Networking – Dial-Up Networking Profile

The newer BTAs support a separate Dial-Up Networking port for use with the Dial-Up Networking profile. To use this profile, the following settings are recommended:

- The BTA should act as the Host Port (bits 0 and 1 = 1)
- The BTA should be discoverable (bit 2 = 1)
- The BTA will act as the acceptor (bit 3 = 0)
- The BTA will use the Dial-Up Networking profile (bit 4 = 1)
- The BTA will use Low Security mode (bit 5 = 1)

This should give us the following setup command:

ATS170=53

When pairing to the BTA, be sure to select the Dial-Up Networking port.

6.1.4 Dial-Up Networking – Serial Port Profile

The newer BTAs use a separate port for Dial-Up Networking via a Serial Port Profile. Like the older BTAs, users will need to add a new serial modem to your laptop or PDA's driver list. Please refer to the Modem Driver appendixes for details.

The setup of the newer BTAs is as follows:

- The BTA should act as the Host Port (bits 0 and 1 = 1)
- The BTA should be discoverable (bit 2 = 1)
- The BTA will act as the acceptor (bit 3 = 0)
- The BTA will use the Serial Port profile (bit 4 = 0)
- The BTA will use Low Security mode (bit 5 = 1)

This should give us the following setup command:

ATS170=53

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

7 Working with Comm

Comm. refers to any features of the LMU that have something to do with the behavior of its wireless modem. This section is intended to cover the Comm related features not discussed in the Activating the CalAmp LMU sections found in the LMU Installation Guides.

7.1 Using a second Comm profile

The Comm profile is the set of parameters the LMU needs to access the wireless network. A profile consists of four values, the Packet Dial-String (Parameter 2316), the network username (Parameter 2314), the network password (Parameter 2315) and the modem driver to use (S-120 or S-150). The first Comm. profile is defined when you activate the LMU. That is, the LMU will use the default Packet Dial String and the supplied username and password. These initial values are stored in index 0 of the Dial-String, username and password Parameters. When using Comm Index 0, the LMU will make use the modem driver defined in S-Register 120.

The second Comm. profile is stored in index 1 of the Dial-String, username and password Parameters and makes use of S-Register 150 for the modem driver. The LMU can be commanded to use this second profile in one of two ways, either controlled via PEG, or controlled by changing the Packet Dial-String-Current Index Parameter (Parameter 2317). For instance, say you have tethered an Iridium data modem to your LMU which is to be used when the internal modem does not have coverage. For this example, the Iridium device uses a Dial-Up Networking phone number of 6195551000. The following commands would set-up the second Comm Profile for use with the Iridium device.:

```
ATS150=144
AT$APP PARAM 2316,1,6195551000
AT$APP PARAM 2314,1,"dummy"
AT$APP PARAM 2315,1,"dummy"
AT$APP PARAM 2317,0,1
```

7.2 GPRS context switching

In the same lines as using a second Comm profile, the LMU can use a second GPRS Context setting. The LMU has the added ability to automatically switch which Context it uses. This switching will occur after a certain number of failures when attempting to dial the GPRS network.

The GPRS Context values are stored in parameter 2306. Keep in mind that the format of the Context string changes depending which device you are using. For the LMU-4100 the Context command would look like:

```
AT$APP PARAM 2306,0,"IP:myapn.myoperator.com"
```

For the LMU-1000 it would look like:

```
AT$APP PARAM 2306,0,"myapn.myoperator.com"
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Up to two Contexts can be defined. The first Context is stored in index 0 of parameter 2306, the second is stored in index 1.

Which Context the LMU will initially use is controlled by the GPRS Context – Current Index Parameter (2307). If the value of this Parameter is 0, the LMU will start with the first Context, if the value is 1 it will start with the second. For instance, to use the second Context you would use:

```
AT$APP PARAM 2307,0,1
```

The automatic switching of the active Context is controlled by S-Register 129. This register defines how many connection attempts the LMU is allowed to make before it automatically switch to the next Context. A failure is indicated by a Comm Disconnect PEG event and/or debug message on the host port.

For example, to set a failure count of 5 you would use:

```
ATS129=5
```

In this case, if the LMU was using the first Context it would allow 5 connection failures before switching to the second. If it fails 5 times on the second, it will switch back to the first.

The automatic switching feature is disabled if S129 is set to 0. By default, S129 is set to 3.

7.3 Automatically resetting the wireless modem

The LMU can automatically reset its internal wireless modem based on a variety of conditions. Please keep in mind that these features only apply to the LMU-4100.

7.3.1 Send fail restart

In some cases it may be desirable to automatically reset the wireless modem based on its inability to send in PEG event reports. This is controlled by the Send Fail Restart Count, which is stored in S-Register 149. If the LMU attempts to send in an event report more than the number of times indicated in S-149, the LMU will automatically reset the wireless modem. A send failure occurs at the following stages:

- when the inbound retry schedule (Ignition on or off) expires
- when a log send retry interval expires

For instance, to reset the wireless modem after 8 send failures you would use:

```
ATS149=8
```

To disable this feature, set S149 to 0.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

7.3.2 Log activity restart

This feature is similar to the Send Fail Restart, only it is time based instead of packet delivery based. In this case, the LMU will reset the wireless modem if the LMU's log space has been active for a specific period of time. This period is defined by S-Register 157 and is stored in minutes. This timer starts when the LMU's log goes active and reset when it empties. As an example, if we want to reset the LMU's wireless modem if the log has been active for 30 minutes we would use:

```
ATS157=30
```

It is highly advisable to set this value to something greater than the length of time it takes the LMU to empty a full log. This can be around 20 minutes depending on the wireless technology employed.

7.3.3 Connection monitoring

The LMU's Connection Monitor is a third means to automatically reset the LMU's wireless modem. In this case, the LMU issues a heartbeat message to the wireless modem in the form of an LCP Echo. If the modem does not respond to three consecutive LCP Echo requests, the LMU will reset the modem. LCP Echoes are sent in two instances; either on a periodic basis or after each LM Direct packet is sent. Please keep in mind that LCP Echoes should only be used with modems that locally maintain a PPP session with the LMU. That is, any device that uses CDMA 1xRTT or a circuit switched session for its data connection MUST NOT use the Connection Monitor[6]. Doing so may violate the network terms of service and/or add significant cost to your wireless data charges.

There are three settings that control the Connection Monitor, one which controls how often the LCP Echo is sent, one that controls the LCP Echo sent after LM Direct packets and one that is a master enable/disable control. The LCP Echo interval is controlled by S-Register 152. The value of this Register is the length of time, in seconds between LCP Echoes. For instance, to use a 20 second interval, the AT Command would be:

```
ATS152=20
```

Setting value S-152 to 0 disables the periodic LCP Echo.

The sending of LCP Echoes after LM Direct packets is controlled by bit 2 of S-154. To enable the sending of LCP Echoes, you would set this bit. That is:

```
AT$APP PARAM 1024,34,4,4
```

To disable the sending of LCP Echoes after LM Direct packets, you would clear bit 2 using:

```
AT$APP PARAM 1024,34,4,0
```

[6] The Connection Monitor is always disabled for both the internal and external CDMA modem drivers regardless of LMU settings.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

The master enable/disable setting is controlled by bit 3 of S-Register 154. Setting this bit will disable the Connection Monitor, clearing it will enable monitoring. To enable the Monitor you would use:

```
AT$APP PARAM 1024,34,8,0
```

To disable it, you would use:

```
AT$APP PARAM 1024,34,8,8
```

When using the LMU to establish a Dial-Up Networking session with a laptop or PDA, it is best to disable the Connection Monitor.

7.3.4 Querying the modem for network status

The LMU periodically polls the modem for network status to populate the Carrier ID and RSSI fields of the LM Direct messages. In the case of CDMA and GSM devices, it is possible to configure how often this occurs. The query interval is controlled by S-Register 153. The value of this register is in seconds. For instance, to program a query every 10s you would use:

```
ATS153=10
```

If the modem fails to respond to 3 consecutive queries, the LMU will reset it.

7.4 PDP Context Reset

This feature only applies to LMU-1000s and is similar to the automatic reset features of the LMU-4100. The LMU-1000's firmware is actually hosted within the wireless modem and thus an automatic reset of the modem is impossible. To attempt to deal with stale data connections or other possible hang ups, the LMU can automatically refresh its PDP Context (i.e. the data session).

The LMU will automatically reset the PDP Context of the wireless modem if there has been no data activity for the length of time indicated by S-Register 172. This timer is always active and is reset every time there is data activity for the modem, either incoming or outgoing. The value of S-Register 172 is in minutes. For example to reset the PDP Context after 30 minutes of inactivity, you would use:

```
ATS172=30
```

7.5 Network selection

The LMU has the ability to Prefer, Require or Exclude a specific network based on that network's ID and the technology employed by the LMU.

If the LMU is set to Prefer a given network, it will first attempt to connect to that network before establishing a data session. If it cannot find that network, it will register to whatever network is available.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

If the LMU is set to Require a given network it must connect to that network before a data session will be established. If the data session is already established and the modem roams off the Required network, the LMU will automatically drop the data session and attempt to reconnect to the Required network.

Lastly, if the LMU is set to Exclude a given network, the LMU will only allow data session to be established or maintained if the LMU is register to a network that is not on the Exclude list.

The LMU can be set for either one Preferred network or one Required network and up to 4 Excluded networks. For each definition, three values are required, the network selection criteria (Prefer, Require or Exclude), the ID of the network in question and the network ID type.

The network selection condition is controlled by Parameter 1537 and contains 4 indexes. Index 0 can be used for the Prefer, Require or Exclude criteria. Indexes 1 – 3 are only used for Exclude values. The value of this register may be set as follows:

- 0=Ignore / Not Used
- 1=Require
- 2=Prefer
- 3=Exclude

The network ID type is always set to 1 if the Index is to be used and 0 if it is off. The network ID type is controlled by Parameter 1536. This Parameter also has 4 Indexes which are associated with the Indexes of Parameter 1537. Again, the values for this Parameter may be:

- 0=Do not use network selection
- 1=Select on SID (CDMA) or MNC (GPRS)

The network ID value is stored in Parameter 1538. Again, this Parameter contains 4 Indexes, which are associated with the Indices of parameter 1537 and 1536. The value of this Parameter may range from 0 to 65535. For CDMA networks, this should be the SID (System ID) of the network in question. For GPRS networks the ID should be the MNC (Mobile Network Code) of the network in question. Please note that GPRS networks will automatically use the MCC (Mobile Country Code) as defined by the IMSI. If your SIMs IMSI does not match the MCC of the network you are using, DO NOT enable the network selection feature.

Keep in mind that most devices already have some measure of network preference built in. It is best to talk to your wireless network carrier on what roaming features / pitfalls exist before using the LMU's network selection capabilities.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

7.5.1 GPRS networks

The GPRS LMU-4100 supports all three options: Require, Prefer and Exclude. For example, to Prefer MNC 380 yet Exclude 170, 180 and 190 you would use the following commands:

Prefer 380:

```
AT$APP PARAM 1537,0,2
AT$APP PARAM 1536,0,1
AT$APP PARAM 1538,0,380
```

Exclude 170

```
AT$APP PARAM 1537,1,3
AT$APP PARAM 1536,1,1
AT$APP PARAM 1538,1,170
```

Exclude 180

```
AT$APP PARAM 1537,2,3
AT$APP PARAM 1536,2,1
AT$APP PARAM 1538,2,180
```

Exclude 190

```
AT$APP PARAM 1537,3,3
AT$APP PARAM 1536,3,1
AT$APP PARAM 1538,3,190
```

7.5.2 CDMA networks

The CDMA LMU-4100 only supports the Exclude option as all roaming capabilities are defined in the PRL in use by the CDMA modem. Please talk to your operator if a customer PRL is necessary.

7.5.3 iDEN networks

The iDEN LMU-4100™ does not support the network selection feature.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

7.6 Controlling the Data Session

For the most part the data session of the LMU is controlled by PEG. The one exception to this is the Power On or Wake-Up behavior. On a Power Up or a Wake-Up the LMU will immediately[7] attempt to establish a data session. This behavior can actually be prevented using bit 7 of S-Register 140. If you set this bit, then the data session will not be attempted on Power Up or Wake Up. If it is cleared, then the LMU will behave as normal.

To prevent the data session on power up, you would use:

```
AT$APP PARAM 1024,20,128,128
```

To enable default behavior, you would use:

```
AT$APP PARAM 1024,20,128,0
```

7.7 Updating the PRL

CDMA devices (modems, phones, data-cards, etc.) use a feature called a Preferred Roaming List (PRL) which defines what networks the devices is allowed to use. For most carriers it is possible to update the PRL by dialing a special number. In the LMU, this number is known as the PRL Dial String and is contained in Parameter 2318. The most common dial string used to update the PRL is *228, so to set the dial string to this value, you would use:

```
AT$APP PARAM 2318,0,"*228"
```

Keep in mind that the LMU automatically defaults the PRL Dial String for the following carriers, so you generally do not need to change this value.

- Verizon Wireless
- Sprint
- Telus Mobility
- Cricket
- Alltel

When the LMU does not have a known default, it will automatically use *228.

A PRL dial can be initiated in one of two ways, either via a PEG Action of Send Special with an Action Modifier of 3 or via an AT Command:

```
AT$APP Modem Update
```

A PRL dial sequence lasts approximately 90s to 2 minutes. The LMU will attempt to re-connect to a data session once the PRL dial is complete.

[7] Immediate is a bit of a misnomer, the LMU powers up the modem, reads several identifiers, scans for a network and THEN tries the data session.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

7.8 Back Off Algorithms

Both the CDMA and GSM LMUs make use of a back-off algorithm when they encounter problems connecting to the wireless network (e.g. registration denied, MIP errors, etc…).

For the GSM LMUs if registration is denied (CREG=3), the modem will be restarted and the registration wait delay will be increased by the delay schedule. The normal delay is 300 seconds. The back-off algorithm increase this time by 0s on the first failure, 900s for the second failure, 1800s for the third failure, and 3600s for any subsequent failure. The PDP session failure back-off requires each of the possible two APNs be attempted with 'n' times (defined by S-Reg 129) before the back-off kicks in. Once active, the connection dial attempt is held off by the same schedule as the registration back-off.

For the CDMA LMUs, the back-off algorithm is: 0s on the first failure, 60s on the second failure, 120s on the third failure, 480s on the fourth failure, and 900s on any subsequent failure.

The iDEN LMUs do not employ any back-off algorithms.

7.9 Working with the Outbound Socket

The Outbound socket is used when a server other than the Inbound Server needs to talk to the LMU (e.g. to send configuration changes or unit request messages). This second server is defined in the second index of the Inbound URL (Parameter 2319, Index 1) and second index of the Inbound Port (Parameter 769, Index 1).

For example, if your Inbound Server was at LMU.MyCompany.com and the Outbound server was at Comm.MyCompany.com you would use:

Setup the Inbound Server:

```
AT$APP PARAM 2319,0,"LMU.MyCompany.com"
AT$APP PARAM 769,0,20500
```

Setup the Outbound Server:

```
AT$APP PARAM 2319,1,"Comm.MyCompany.com"
AT$APP PARAM 769,1,20500
```

The Outbound Socket is only available on the following LMU products:

- MTU-100™
- LMU-900™
- LMU-1100™
- LMU-1200™

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

8 Controlling LMU Access

The LMU has a variety of security features that will limit access to various functions within the LMU. It is very important that you do not change any of the default settings for these features until you fully understand the implications of doing so.

8.1 Service Enables

The Service Enables Parameter allows a user to enable or disable various features of the LMU. The following four items are controlled by this parameter:

- **TAIP Interface**
  This feature controls the LMU's ability to create and respond to TAIP messages.
- **Inbound/User Messaging**
  This feature controls the LMU's ability to create and process User Messages from MDTs, either on the Host Port or Aux Pot.
- **Event Reporting**
  This feature controls the LMU's ability to generate Event Reports, either via PEG or via AT Command. Keep in mind that the rest of the PEG Script would still be operational.
- **PEG Processing**
  This feature allows users to turn the processing of the PEG Script on or off.

The Service Enables are controlled by Parameter 1025. Like many of the LMU's Parameters, the Service Enables are bit mapped. If a bit is set, then the associated feature is enabled. If a bit is cleared, then the feature is disabled. By default, PEG Processing, Event Reports and Inbound/User Messaging are enabled. Only the TAIP interface is disabled. The feature bit mapping is as follows:

- Bit 3 = TAIP Interface
- Bit 2 = Inbound Messaging
- Bit 1 = Event Reports
- Bit 0 = PEG Processing

To enable all the features you would use the following commands:

TAIP Interface:

```
AT$APP PARAM 1025,0,8,8
```

Inbound Messaging:

```
AT$APP PARAM 1025,0,4,4
```

Event Reporting:

```
AT$APP PARAM 1025,0,2,2
```

PEG Processing:

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

```
AT$APP PARAM 1025,0,1,1
```

The corresponding disable commands would be:

TAIP Interface:

```
AT$APP PARAM 1025,0,8,0
```

Inbound Messaging:

```
AT$APP PARAM 1025,0,4,0
```

Event Reporting:

```
AT$APP PARAM 1025,0,2,0
```

PEG Processing:

```
AT$APP PARAM 1025,0,1,0
```

8.2 Access IP Address List

When the LMU receives a UDP packet[8] it compares the source IP address with those contained in its Access IP Address list. If the LMU finds a match, then the LMU will process and, if needed, respond to the incoming packet. If the LMU does not find a match it will ignore the message. By using this list is it therefore possible to control which servers the LMU will and will not respond to.

Up to four IP addresses can be assigned to this list. If an octet is set to 255, that octet is treated as a wild card to allow filtering on a subnet level. For instance, the default value in the Access IP Address list is 255.255.255.255. This IP will allow the LMU to respond to any IP address.

It is **very** important to have at least one value on this list. If all four IP addresses are cleared (i.e. set to 0.0.0.0), the LMU will not respond to any messages from any server or application. You will need to visit the LMU in person and alter the settings via a serial cable.

It is also important to keep one of the addresses set to the PULS IP address (207.71.209.248). If you choose to leave the PULS IP address off this list, then you will not be able to take advantage of any of PULS' features.

The Access IP Address list is controlled by Parameter 1281 and contains 4 Indexes (0 – 3). Each Index defines a new IP address.

For example say we wish to limit the LMU to three IP addresses, the IP of PULS, the IP address range used by your office and the IP address range used by your data hosting facility[9].

[8] This could be an LM Direct message or a TAIP sentence

[9] This sort of setup would have access to PULS, a development LM Direct server hosted in your office and a production LM Direct server hosted in your data center.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

The current IP address for PULS is 207.71.209.248.

For this example, the IP range used by your office is 166.143.185.65 thru 166.143.185.90 and the IP range used by your data hosting facility is 172.90.80.240 thru 172.90.81.50[10].

To set up an appropriate access list you would use the following commands:

PULS:

```
AT$APP PARAM 1281,3,207.71.209.248
```

Office:

```
AT$APP PARAM 1281,2,166.143.185.255
```

Data Center:

```
AT$APP PARAM 1281,1,172.90.255.255
```

One question that should pop to mind here is why we began with index 3 instead of 0. This was because the default IP address is stored in index 3, since we wanted to limit access; we needed to make sure that the default value was over-written or deleted.

Keep in mind that the Access IP Address list also controls the LMU's ability to react to Acknowledgements. If the LMU receives an acknowledgement from a server that is not on its Access IP Address list, then it will ignore that acknowledgement and attempt to re-deliver the message.

8.3 Remote Host IP Address List

The Remote Host IP Address list is similar to the access list, in that it limits the LMU's ability to talk to certain IP addresses. In this case, the Remote Host IP Address list controls which address a Host Device (i.e. laptop or PDA) can get to when connected to the LMU via a Dial-Up Networking session. The idea here is to restrict an end-users ability to do things like browse the web or check email so as not to run up excessive data charges.

The Remote Host IP Address list is controlled by Parameter 1282 and contains 4 Indices (0 – 3). Each Index defines a new IP address and, like the Access IP Address list, an octet of 255 indicates a wild-card value. The Remote Host IP Address list has one entry by default stored in Index 0. This is 255.255.255.255 to allow access to any remote IP addresses.

We will use the same IP ranges above for this example under the assumption that your office and data center are hosting an IP based application that the end user needs access to. (For instance, a POP3 mail server and SMTP server).

As a reminder, the IP range used by your office is 166.143.185.65 thru 166.143.185.90 and the IP range used by your data hosting facility is 172.90.80.240 thru 172.90.81.50[11].

[10] With the exception of the PULS address, these IPs were chosen at random.
[11] With the exception of the PULS address, these IPs were chosen at random.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

To set up an appropriate Host Access List you would use the following commands:

```
AT$APP PARAM 1282,0,166.143.185.255
AT$APP PARAM 1282,1,172.90.255.255
```

In this case you should notice two differences from above, first is that we started with Index 0 since this is where the default value sits. The second this is that we didn't need to put PULS's IP address in the list.

8.4 Primary Port Password

The last security feature of the LMU is the Primary Port Password. The password is a 4 byte number that is programmed into the LMU using Parameter 1283. This password must be present in the options header of any LM Direct message. If it is not present or is incorrect, the LMU will not process that message. Please refer to the LM Direct Reference Guide on how the password is included in the LM Direct options header.

For example, to set a password of 1234 you would use:

```
AT$APP PARAM 1283,0,1234
```

Keep in mind that PULS does not support the Primary Port Password feature and thus enabling it will effectively disable your ability to use PULS.

A password of 0 disables this feature and is also the default value.

Passwords can only be applied to the LM Direct interface. They are not available for TAIP or SMS.

8.5 AT Command Password

It is possible to restrict the LMU's ability to process AT Commands by an AT Command Password. The password itself is store in Parameter 2177(Short Text String), Index 0 and is enabled by setting Bit 4 of S-Register 171.

Once the password has been set, and the mode is enabled, users must enter the password before any AT Commands will be processed. If a password is not entered, the LMU will respond with **"Password Required".**

To enter the password you would use:

```
AT$PW "<password>"
```

The LMU will remain in an unlocked state until it is power cycled. Please note that the LMU will remember the locked/unlocked state through a sleep cycle.

To program a password you would use:

```
AT$APP PARAM 2177,0,"<password>"
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Because the password is stored in a Short Text String it is limited to 15 alpha numeric ASCII characters.

To enable this feature you would use:

```
AT$APP PARAM 1024,51,16,16
```

To disable this feature you would us:

```
AT$APP PARAM 1024,51,16,0
```

Be aware that this password also applies to AT Commands sent via SMS. To remotely unlock an LMU via SMS you would use a variant of the !R0 SMS message.

```
!R0P<password>
```

The sending phone number will then be cleared to process any AT Commands over SMS until the LMU is either power cycled, or it receives an unlock command via SMS from a new phone number. As a result, only one phone number can have remote AT Command access to an LMU at a time.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

9 Working with GPS

Obviously one of the most important pieces of the LMU is the GPS Receiver. This section describes the supporting features that exist outside of PEG which can affect the behavior of the GPS Receiver.

9.1 NMEA Messaging

One of the more common uses of a GPS Receiver is to feed NMEA data into a real-time mapping application that is running on a laptop or PDA. The LMU's support of this feature is described in the Working with Serial Devices section.

9.2 GPS Timeouts

The LMU has 3 timers which affect the behavior and status of the GPS Receiver.

9.2.1 Last Known Timeout

This timer affects the contents of the Fix Status byte of an LM Direct message. The Fix Status is meant to describe the GPS data being reported in the LM Direct message. This specific timer controls how long the LMU will wait before setting the Last Known bit of the Fix Status byte after losing GPS lock. When the LMU regains lock, the Fix Status byte is immediately cleared.

The purpose of the delay is to handle cases of temporary outages, such as the LMU travelling under a bridge or through a short tunnel.

The Last Know Timeout is controlled by Parameter 1028 and is defaulted to 60s. The value of this Parameter is in seconds. For example, to set it to 45s you would use:

```
AT$APP PARAM 1028,0,45
```

9.2.2 GPS Lost

This timer effect when the GPS Lost PEG Trigger is fired. Like the Last Known Timer, it starts when the LMU loses GPS lock. When the Timer expires, the GPS Lost PEG Trigger is fired. If the LMU regains GPS while the Timer is active, the Timer is immediately stopped and reset to its starting value.

This feature is to prevent excessive GPS triggers during temporary GPS outages (e.g. driving under a bridge or through a short tunnel).

This Timer is controlled by Parameter 1027 and is defaulted to 60s. The value of this Parameter is stored in seconds. For example to set the timer to 90s you would use:

```
AT$APP PARAM 1027,0,90
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

9.2.3 GPS Restart

In some cases it may be desirable to have the LMU automatically reset the GPS Receiver outside of the PEG script. This timer, which is controlled by S-Register 144, is the length of time the LMU will wait after losing GPS signal before resetting the GPS Receiver. The value of this Register ranges from 1 to 255 minutes with a value of 0 disabling the reset. It is VERY important that this value be long enough to allow the LMU to gain GPS lock. For instance a value of 1 minute could ensure that the LMU never gains a GPS lock while in a challenging GPS environment. A value of 5 minutes is the recommended minimum.

9.3 Pinning

When a GPS receiver is stationary the position it produces does not remain static. That is, the position will actually drift and move over time. The idea behind Pinning is to only update the LMU's current position when a 'better' position is received. This is to help prevent drift that could give false moving reports or other GPS events.

Pinning is controlled by 3 S-Registers, 156, 142 and 174.

9.3.1 Enable / Disable pinning

Pinning is turned on or off by setting or clearing bit 0 of S-Register 156. To enable Pinning you would use:

```
AT$APP PARAM 1024,36,1,1
```

To disable Pinning you would use:

```
AT$APP PARAM 1024,36,1,0
```

9.3.2 Using Ignition to control Pinning

The LMU can use its ignition line to decide if it should apply its Pinning logic. When ignition control is enabled, the LMU will Pin the position when the ignition off. Pinning will not be used when the ignition is on.

If ignition control is disabled then Pinning begins once the LMU drops below its Moving Speed Threshold[12]. Pinning is stopped when the LMU exceeds its Moving Speed Threshold. Ignition control is enabled by clearing bit 1 of S-Register 156.

```
AT$APP PARAM 1024,36,2,0
```

It is disabled by setting bit 1.

```
AT$APP PARAM 1024,36,2,2
```

[12] See the PEG Programming Guide for details on the Moving Speed Threshold

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

9.3.3 GPS Accuracy Threshold

The GPS receiver produces a Horizontal Accuracy Estimate for each position it produces. The LMU uses this estimate to decide if it should update its position when Pinning. This estimate threshold is controlled by S-Register 142. If the new position of the GPS Receiver has an estimate lower than the value in S-142 then the LMU will allow its position to be updated, otherwise the new position is ignored.
The value of S-142 is in meters. For instance, to set a limit of 10m or better, you would use:

```
ATS142=10
```

9.3.4 GPS Fix Quality

The LMU can use its GPS Fix Quality threshold to decide if it should update a pinned position. If the fix quality received from the GPS receiver is better than the threshold, then the pinned position is updated, otherwise the position remains the same. The Fix Quality is defined in bits 0-2 of S-Register 174.

The available settings for S-174 are:

- 0 = Threshold Off
- 1 = Sat Count >= 4 and HDOP <= 3.0
- 2 = Sat Count >= 4 and HDOP <= 2.0
- 3 = Sat Count >= 5 and HDOP <= 2.0
- 4 = Sat Count >= 5 and HDOP <= 1.5
- 5 = Sat Count >= 6 and HDOP <= 1.5
- 6 = Sat Count >= 7 and HDOP <= 1.5
- 7 = Sat Count >= 8 and HDOP <= 1.2

For example, to set a threshold of 5 or more satellites with an HDOP of 1.5 or less you would use:

```
AT$APP PARAM 1024,54,7,3
```

To disable the threshold you would use:

```
AT$APP PARAM 1024,54,7,0
```

Please note that S-174 can also be used by PEG in relation to its Moving/Not Moving Trigger and its GPS Fix Quality Condition.

9.3.5 The effects of Pinning

When the LMU's position is pinned, the latitude and longitude it reports will be the Pinned values and not necessarily the latest position produced by the GPS Receiver. This will affect the contents of an LM Direct, or SMS message in a couple of ways. First off, the Fix Status bit will indicate that the position is predicted. The second change is that the Time of Fix value will be the time of the last update used from the GPS Receiver (i.e. the Pinned location) and may not be the actual time that the message was created. That value will be in the Update Time field.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

It is very important to note that the NMEA data produced by the LMU is not subject to Pinning, therefore the position reported in a real-time mapping application may differ from the position reported via LM Direct, or SMS.

9.4 Special Functions

9.4.1 Receiver Mode

The GPS receiver supports a number of 'modes' for tracking. The Receiver Mode controls the GPS receiver's internal filters. The looser the setting (i.e. High Dynamic Aircraft) the noisier the position will be. It is best to choose the least dynamic environment setting that will still track. That is, if the LMU is to be installed in a car, use the automotive setting. If the LMU (i.e. the MTU-100) is on a person then use the pedestrian setting. The available settings are:

- Stationary (1)
- Pedestrian (2)
- Automotive (3)
- At sea (4)
- Airborne low dynamics (5)
- Airborne medium dynamics (6)
- Airborne high dynamics (7)

The receiver mode is controlled by bits 0 – 2 of S-Register 139. To select a specific mode, set these bits to the value referenced above. For example, so set the LMU to use the Automotive GPS Receiver mode you would use:

```
AT$APP PARAM 1024,19,7,3
```

9.4.2 Enabling SBAS Support

A Satellite Based Augmentation System (SBAS) is a system that supports wide-area or regional augmentation of GPS positioning through the use of additional satellite-broadcast messages. Such systems are commonly composed of multiple ground stations, located at accurately-surveyed points. The ground stations take measurements of one or more of the satellites, the satellite signals, or other environmental factors which may impact the signal received by the users. Using these measurements, information messages are created and sent to one or more satellites for broadcast to the end users.

The LMU can enable the use of SBAS in the GPS Receiver by setting bit 4 of S-Register 139.

```
AT$APP PARAM 1024,19,16,16
```

9.4.3 Elevation Filter

The LMU's Elevation Filter controls the minimum elevation a satellite needs to have for it to be used in the GPS position calculation. The two options are a 15° filter and a 5° filter. The

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

15° filter is enabled by setting bit 5 of S-Register 139. The 5° filter is enabled by clearing bit 5 of S-Register 139.

To enable the 15° filter you would use:

```
AT$APP PARAM 1024,19,32,32
```

To enable the 5° filter you would use:

```
AT$APP PARAM 1024,19,32,0
```

In general it is best to use the 5° filter for high dynamic applications (e.g. Automotive and above) and the 15° filter for low dynamic applications (e.g. pedestrian or stationary)

9.4.4 Using Active or Passive GPS Antennas

There are two types of GPS antennas available, an active antenna, and a passive antenna. An active antenna contains a LNA (low noise amplifier) which receives power from the GPS Receiver through the antenna cable. This is meant to allow the GPS Receiver to use weaker GPS signals to produce its location solution.

A passive GPS antenna is not powered and thus the supply voltage normally produced by the GPS Receiver must be turned off. If the voltage is left on, it may actually damage your antenna and reduce the overall performance.

By default the LMU assumes it is using an active GPS antenna.

To enable use of a passive GPS antenna you would set bit 5 of S-Register 139.

```
AT$APP PARAM 1024,19,32,32
```

To re-enable the use of an active GPS antenna you would clear bit 5 of S-139.

```
AT$APP PARAM 1024,19,32,0
```

9.4.5 Update Rate

The LMU supports 2 GPS update rates, a 1Hz rate or a 4Hz rate. At present, the update rate only affects how often NMEA data is presented on the serial port when NMEA messaging is enabled. This value is controlled by bit 7 of S-Register 139. If this bit is set, the LMU uses a 4Hz update rate. If this bit is cleared it uses a 1Hz update rate.

To enable a 4Hz update rate you would use:

```
AT$APP PARAM 1024,19,128,128
```

To enable a 1Hz rate you would use:

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

```
AT$APP PARAM 1024,19,128,0
```

9.5 Local GPS Messaging

While connected to the LMU's host port, it is possible to enable further GPS messaging beyond or instead of NMEA. Two of these messages are intended for use with MDTs while the other is used for GPS debug.

9.5.1 Odometer Message

The ODO message is meant for use with MDTs to provide a compact description of the current position of the LMU including an odometer estimate.

The message has the following format:

```
ODO,<time of
fix>,<latitude>,<longitude>,<heading>,<speed-
mph>,<speed-cm/s>,<HDOP>,<number of sats>,<Max
Speed>,<odo-skip>,<odometer>
```

<time of fix>

This is the time of fix as produced by the GPS Receiver. It is displayed in seconds since 00:00:00 of Jan 1, 1970.

<latitude>

This is the latitude produced by the GPS Receiver in decimal degrees. The value is scaled by 10^7. Please note that this value is subject to pinning

<longitude>

This is the longitude produced by the GPS Receiver in decimal degrees. The value is scaled by 10^7. Please note that this value is subject to pinning

<heading>

This the heading value produced by the GPS Receiver in degrees from true north.

<speed-mph>

This the speed reading produced by the GPS Receiver in miles per hour.

<speed-cm/s>

This the speed reading produced by the GPS Receiver in centimeters per second.

<HDOP>

This is the Horizontal Dilution of Precision value produced by the GPS Receiver scaled by 100.

<number of sats>

This is the number of satellite the GPS Receiver is using to compute its position.

<Max Speed>

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

This is the maximum speed the GPS Receiver has produced since the LMU was powered up. This value is in centimeters per second

<odo-skip>

This value is an 'as the crow files' distance value computed between two GPS positions. This computation occurs when the LMU regains GPS signal after losing it for more than 1 second. This value is in meters.

<odometer>

This is the overall distance the LMU has travelled since power up. The value is displayed in meters.

The ODO message is enabled by setting bit 0 of S126 and having general debug enabled.

```
AT$APP PARAM 1024,6,1,1
ATS125=3 (or ATS125=7)
```

It is disabled either by clearing Bit 0 of S126 or turning general debug off:

```
AT$APP PARAM 1024,6,1,0
ATS125=0
```

9.5.2 Position Update Message

The POS message, like the ODO message is meant to provide a compact description of the current GPS position of the LMU. This message can be displayed in two formats, either as a NMEA RMC message or as a POS message. This choice of format is controlled by S-Register 156. If bit 2 is set, then the message is presented in the NMEA RMC format. If bit 2 is cleared then it appears as a POS message. The message is displayed in accordance to the update rate.

To display an RMC message you would use:

```
AT$APP PARAM 1024,36,4,4
```

To display a POS message you would use:

```
AT$APP PARAM 1024,36,4,0
```

The POS message can also be displayed in response to the Display Position PEG Action.

The POS message format is as follows:

```
POS,<parameter>,<time of
fix>,<latitude>,<longitude>,<heading>,<speed>,<HDOP>,<
number of sats>,<fix status>
```

<parameter>

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

This value is the Action Modifier associated with the Display Position PEG Action. If the POS message is produced automatically (i.e. not through PEG), this value will be 0.

<time of fix>

This is the time of fix as produced by the GPS Receiver. It is displayed in seconds since 00:00:00 of Jan 1, 1970.

<latitude>

This is the latitude produced by the GPS Receiver in decimal degrees. The value is scaled by 10^7. Please note that this value is subject to Pinning

<longitude>

This is the longitude produced by the GPS Receiver in decimal degrees. The value is scaled by 10^7. Please note that this value is subject to Pinning

<heading>

This the heading value produced by the GPS Receiver in degrees from true north.

<speed>

This the speed reading produced by the GPS Receiver in centimeters per second.

<HDOP>

This is the Horizontal Dilution of Precision value produced by the GPS Receiver scaled by 100.

<number of sats>

This is the number of satellite the GPS Receiver is using to compute its position.

<fix status>

The current fix status of the GPS Receiver bitmapped as follows:

Bit 0 – Predicted
Bit 1 – Differentially Corrected
Bit 2 – Last Known
Bit 3 – Invalid Fix
Bit 4 – 2D Fix
Bit 5 – Historic
Bit 6 – Invalid Time

This message is enabled by setting bit 1 of S-126.

```
AT$APP PARAM 1024,6,2,2
```

Is it disabled by clearing bit 1.

```
AT$APP PARAM 1024,6,2,0
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Unlike the ODO message, general debug does not need to be enabled.

9.5.3 GPS Debug Output

GPS Debug Output enables a variety of debug messaging the LMU receives from its GPS receiver. This messaging should only be enabled when requested by a member of CalAmp's support team.

It is enabled by setting bit 2 of S-Register 126 and enabling general debug. That is:

```
AT$APP PARAM 1024,6,4,4
ATS125=3 (or ATS125=7)
```

It is disabled by clearing bit 2 or turning off general debug.

```
AT$APP PARAM 1024,6,4,0
ATS125=0
```

9.6 Over-The Air Real-Time GPS Updates

It is possible to have the LMU produce an LM Direct event report every time the GPS receiver supplies a new GPS position. How often this occurs is based on the GPS Update rate.

The LM Direct Event Report is sent using the Unacknowledged service and goes to the current Inbound Address and Port in use by the LMU. This feature is enabled by setting bit 4 of S-Register 126.

```
AT$APP PARAM 1024,6,16,16
```

This feature is disabled by clearing bit 4

```
AT$APP PARAM 1024,6,16,0
```

This feature is disabled by default.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

10 CalAmp LMU Interface – LM Direct

The primary interface to the LMU once it is in the field is LM Direct. LM Direct is a UDP/IP based protocol that allows you to:

- Receive location data from the LMU based on the PEG Script
- Request location and status data from the LMU based on Unit Request messages
- Send and Receive User Messages to/from host serial devices
- Make configuration changes to various LMU parameters.

The LM Direct protocol is discussed in detail in the LM Direct Reference Guide. The discussion that follows describes the LMU's various configuration settings that support the LM Direct interface.

10.1 Using the LM Direct Protocol

In order to use the LM Direct Protocol it must be enabled. This is done using S-Register 140. If bit 4 is set, then the LM Direct protocol is enabled. If it is cleared, then the LMX[13] protocol is enabled. To enable LM Direct, you would use:

```
AT$APP PARAM 1024,20,16,16
```

The LM Direct protocol is, of course, enabled out of the factory, so this is usually an unnecessary step.

10.2 Inbound Settings

The destination for all LM Direct data created by the LMU is known as the Inbound settings, which are made up of three Parameters:

- **Inbound IP Address (Parameter 768)**
  The Inbound IP address is the IPv4 address of your backend system
- **Inbound Port (Parameter 769)**
  The Inbound Port is the UDP port number your server is listening on for LM Direct packets. This is generally set to 20500.
- **Inbound URL (Parameter 2319)**
  The Inbound URL allows the LMU to look-up the Inbound IP Address using DNS. If the DNS look-up is successful, then the LMU will over-write the Inbound IP address with the new value. If the DNS look-up fails, then the LMU will use the current Inbound IP Address. This feature was designed to allow users to easily change IP Addresses of the backend system without having to update the configuration of every LMU in a given fleet
  Users may also enter an IP Address directly in this field. (eg 192.168.0.1)

[13] LMX is an older protocol in the LMU and is only present for reasons of backwards compatibility. It is no longer officially supported by CalAmp.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

The DNS look-up occurs every time the LMU successfully connects to the network or 15s after a Parameter update.

The initial configuration of the LMU's Inbound settings is generally handled by AT Command. The first step is to program the Inbound IP address and Port using:

```
AT$APP INBOUND <IP address> <port>
```

The second step is to program the Inbound URL:

```
AT$APP Param 2319,0,"<url>"
```

It is very important that you program the URL as well as the Inbound IP address and Port. Not setting the URL value may change the Inbound IP Address to something you are not expecting. If you are not using a URL it is best to set this field to a null value. That is:

```
AT$APP Param 2319,0,""
```

For example, say your inbound IP address is 192.168.0.1 and you have a URL of lmu.myDomain.com. The two commands you would use to configure the Inbound settings are:

```
AT$APP INBOUND 192.168.0.1 20500
AT$APP PARAM 2319,0,"lmu.MyDomain.com"
```

Out of the factory, the LMU will have the Inbound settings configured to an IP of 0.0.0.0 and an empty URL. The port should be 20500.

Only the LMU-4100™ and LMU-2500™ use the Inbound IP Address values. The other devices all use the Inbound URL.

10.2.1 Message Logging

When it comes to logging, there are three reporting modes that can be used with the LMU. They are commonly referred to as the following:

- **Store and Forward (SNF):** When a message is created using Store and Forward the LMU will attempt to immediately send the data if the network is available and if no other data is in the log. Once the message is sent, the LMU will wait for an Acknowledgement message from the receiving server. If one is not received, the LMU will log the data. Any logged data will be sent at a later point in time. If the LMU is either not online, or the log is already active, the new data is placed at the end of the log.
  In PEG, the phrases SEND or SEND-LOG indicate a message is created using the Store and Forward mechanism.
- **Batch:** In batch mode the LMU will immediately place the data in the log regardless of network and log states. The LMU will hold this data until it is explicitly told to

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

empty its log using a SEND LOG Action or a message using the Store and Forward mechanism is introduced.
In PEG, an Action using just LOG operates in batch mode.

- **Unacknowledged:** Unacknowledged messages are ones that are never logged. The LMU attempts to send the data if the network is available. Once the send has been completed, the message is erased. If the network is not available, then the message is immediately deleted.

Which mode is in use primarily dictated by PEG, though the log can be placed in Batch mode on power up by setting bit 5 of S-register 140. That is:

```
AT$APP PARAM 1024,20,32,32
```

To boot the LMU in Store and Forward mode, you would clear bit 5.

```
AT$APP PARAM 1024,20,32,0
```

By default, the log of the LMU will be in Store and Forward mode.

10.2.2 Working with Retry Schedules – Inbound Retries

The Inbound Retry Schedule (Parameter 771) occurs when the LMU is using the Store and Forward log mode. The Schedule dictates two things, the number of times the LMU will attempt to send an LM Direct packet to the inbound IP Address and the delay between each attempt. Up to 6 attempts may be defined with each interval ranging from 0 to 255s. Each attempt is associated with a different Index value of Parameter 771. The values within each Index contain the delay until the next attempt As an example, say you wish to set up three retries growing from 5s[14], to 10s and finally to 15s. The following three AT Commands would accomplish this:

```
AT$APP PARAM 771,0,5
AT$APP PARAM 771,1,10
AT$APP PARAM 771,2,15
```

When the schedule expires, the LMU officially logs the data. That is, the Historic bit of the Fix-Status field will be set and the Log Active PEG trigger will occur.

Please note that the LMU will stop processing the Inbound Retry Schedule when it encounters the first 0s value.

By default the LMU is set to two attempts with a 15s delay between each.

10.2.3 Working with Retry Schedules – Log Retries

The Log Retry Schedule begins when the LMU's log goes active and it is in Store and Forward mode. In this mode, the LMU will attempt to send the first message in its log once

[14] Actually 5s is a little too short for an inbound retry. You should really use 10s or greater for each attempt you wish to define.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

a log retry interval expires. If the log successfully empties, the Retry Schedule is halted and reset. If not, the LMU will wait for the next retry attempt. When the Log Retry Schedule expires, then the LMU will only attempt to deliver data when a new record is introduced into the log, or if the LMU establishes a new data session with the wireless network.

The Log Retry Schedule is based on the state of the LMU's ignition sense.

The Log Retry Schedule is made up of two values, the number of retry attempts to be made and the delay between each attempt. For the ignition on case, these settings are controlled by Parameters 1032 for the number of attempts and 1031 for the delay between each. For the ignition off case, the number of attempts and their associated delay are controlled by Parameters 1034 and 1033 respectively.

For example, say you wish to set up an aggressive ignition on Log Retry Schedule of 10 attempts with a 2 minute delay and a fairly passive ignition off Schedule of 1 attempt every hour over 8 hours. You would use the following four commands:

```
AT$APP PARAM 1032,0,10
AT$APP PARAM 1031,0,120
AT$APP PARAM 1034,0,8
AT$APP PARAM 1032,0,3600
```

10.2.4 Using Multiple Inbound Addresses

The LMU-2500™ and LMU-4100™ can support up to 4 Inbound IP Addresses and Port combinations. This is to allow users to set up back-up servers that the LMU will automatically report to should the primary system fail. The Inbound IP Addresses are stored in Parameter 768 and would be programmed using:

```
AT$APP PARAM 768,<index>,<IP address>
```

Remember, that for 4 values, the Index would range from 0-3.

Parameter 769 controls the Port values and is programmed using:

```
AT$APP PARAM 769,<index>,<port>
```

The Indexes of both these Parameters are tied together. That is, the IP Address for Index 0 will use the Port value of Index 0.

The LMU can also support 2 Inbound URL values which are associated with the 1st and 2nd Indexes (0 & 1) of the Inbound IP Address list. That is, a look up on URL 0 will over-write Inbound IP Address 0 and a look-up on URL 1 will over-write Inbound IP Address 1.

The LMU, from a Power Up, will begin at the first Inbound IP Address. If the LMU fails to deliver data to this server, then it will roll-over to the next IP Address in the list. This will continue to happen until the LMU either successfully delivers data (that is, it gets an

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

appropriate acknowledgement) or it reaches the bottom of its Inbound list. Upon reaching the bottom, the LMU will wrap back to the top of the list and try again. The selection of the next IP address will occur when the Inbound Retry Schedule expires or when the Log Retry Schedule expires.

The LMU provides several modes to handle which inbound address is used.

10.2.4.1 Dynamic Inbound Address

Dynamic Inbound Address mode allows the LMU to automatically switch its Inbound address based on the last IP address to contact the LMU. If the LMU is unable to deliver a report to the new IP address or has never been contacted, it will use its normal Inbound IP Address list.

To enable this mode, bit 2 of Parameter 1280 must be cleared.

```
AT$APP PARAM 1280,0,4,0
```

It should be noted that the LMU will not dynamically redirect the port number. The LMU will use the first port number in its Inbound Port list (i.e. Parameter 769, Index 0). To include the port number in the Dynamic redirection you must set bit 5 of Parameter 1280

```
AT$APP PARAM 1280,0,32,32
```

10.2.4.2 Static Inbound Address

While in Static Inbound mode, the LMU will not switch its Inbound IP address based on the last message received. That is, the LMU's inbound reporting is locked to the contents of the Inbound IP Address List (i.e. Parameter 768). This is the default mode of the LMU.

Static Inbound is enabled by setting bit 2 of Parameter 1280.

```
AT$APP PARAM 1280,0,4,4
```

Please note that the Static Inbound setting will over-ride both the Dynamic and Random Inbound modes.

10.2.4.3 Random Inbound Address

Random Inbound dictates how the first IP Address the LMU uses is chosen. From Power Up, the LMU will randomly select which Inbound IP Address it will use (0-3). If the LMU is unable to send data to that IP Address, it will progress through the rest of the inbound IP addresses as if it were in Standard Mode. That is, it will select the next in the list and make another attempt. If it reaches the bottom of the list, it will return to the top until it gets a data delivery acknowledgement.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

10.2.4.4 Fixed Inbound Address Index

When in Fixed Inbound Address mode, the LMU-2500 or LMU-4100 will not change its Inbound IP address based on a send failure. To enable this mode, Bit 6 of Parameter 1280 must be set. The only time the inbound address will change is on a Comm Select PEG Action.

```
AT$APP PARAM 1280,0,64,64
```

Please note that the Fixed Inbound setting will over-ride the Dynamic, Static and Random Inbound modes.
This mode is not supported on the MTU-100, LMU-900, LMU-1000, LMU-1100 and LMU-1200.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

10.3 Maintenance Settings

The Maintenance settings of the LMU are used to communicate with the PULS system. They define what IP address and port the Maintenance data should be sent to. They also define how often the Maintenance Message should be created. The Maintenance Message is the LM Direct ID Report and thus does not contain any location data about the particular LMU.

10.3.1 Maintenance Delivery

Like the Inbound settings, the Maintenance settings consist of an IP address, Port and URL for the LMU-2500™ and LMU-4100™ which are controlled by Parameters 2310, 2311 and 2320 respectively. The other LMU products (MTU-100™, LMU-1000™, LMU-1100™ and LMU1200™) just support the Maintenance Port and URL Parameters. Users should not adjust these settings unless explicitly told to do so by CalAmp support personnel. Changing these values may limit your ability to use PULS to manage your LMUs.

10.3.2 Maintenance Configuration

The Maintenance Configuration Parameter (2312) controls if the LMU will create Maintenance reports. Again, you should not adjust this field as it may impact your ability to use PULS, however, if you wish to explicitly disable the Maintenance Message you would use:

```
AT$APP PARAM 2312,0,15,0
```

To re-enable it, you would use:

```
AT$APP PARAM 2312,0,15,1
```

10.3.3 Maintenance Interval

The LMU creates Maintenance Messages at two points. The first is the initial connection to the wireless network after a Power-Up or Wake-Up event. If you wish to set the LMU to send an ID report to PULS with every connection to the network, you would use:

```
AT$APP PARAM 2312,0,15,2
```

The second is after the Maintenance Interval has expired. The Maintenance Interval is controlled by Parameter 2322 and is defaulted to 24 hours. This counter is reset every time the LMU creates a Maintenance Message. The value of this parameter is in seconds. For instance, to raise the Maintenance Interval to once every 12 hours you would use:

```
AT$APP PARAM 2322,0,43200
```

10.4 Null Messaging

The LM Direct Null Message was created to refresh the UDP/IP path through wireless network firewalls so the back-end system could asynchronously contact the LMU while attempting to keep data usage to a minimum. Null Messaging is controlled by the Null

Copyright ©CalAmp DataCom Inc 2009

Message Interval in Parameter 2313. Keep in mind use of the Null Message may have noticeable impacts on you data usage if the interval is set to an extremely low value. The Null Message Interval can range from 1 to 65535s. A value of 0 disables the Null Message. For example, to set a 2 minute Null Message Interval you would use:

```
AT$APP PARAM 2313,0,120
```

If another LM Direct message is sent before the Null Message Interval expires, the Interval is reset. This is meant to keep data usage to a little as possible.

The Null Message is sent using the Unacknowledged service and thus is never logged.

10.5 Changing the Local Port

The LMU's Local Port is used to listen for Outbound (i.e. Server to LMU) LM Direct messages. This UDP port number can be changed by altering Index 0 or Parameter 774. For example to set the LMU to use a port number of 9000[15] you would use:

```
AT$APP PARAM 774,0,9000
```

This field is defaulted to 20510 unless otherwise defined.

[15] It is generally a bad idea to use well known UDP Port numbers for either the Inbound or Local Port settings.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

11 CalAmp LMU Interface – SMS

Short Message Service (SMS) is a communications protocol allowing the interchange of short text messages between mobile telephone devices. SMS is supported on all CalAmp devices except the iDEN LMU-4100™.

SMS is generally used as an alternative or as an augmentation to LM Direct. That is, SMS can be used to:

- Report data
- Send remote requests to the LMU
- Re-program Parameters

While LM Direct tends to support more flexibility and functionality than SMS, SMS does have one main advantage. SMS messages can be sent from any SMS enabled phone[16] where LM Direct packets might be limited to a single server and period of time due to firewall and routing rules. Of course the main disadvantage of SMS messages is that they are not logged. The LMU will attempt to send SMS messages when requested, but, if they fail to reach their destination they are lost.

The other important item to consider is that SMS only works for LMUs with internal modems. Anything using an external or generic modem driver does not support SMS.

11.1 Reporting Data via SMS

The LMU's SMS capabilities support three mobile originate messages, the SMS Event Report, the Text Status Message and Short and Long Text Messages The generation of each of these messages is controlled by PEG and you should refer to the PEG Programming guide for details. The following sections only describe the format of each of these messages.

[16] So long as your phone's operator has an SMS exchange agreement with the network the LMU is on.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

11.1.1 SMS Event Report

The SMS Event Report is much like the LM Direct Event Report in that it is meant to contain a useful set of location and unit status data. It should be noted that the SMS Event Report will contain less data than the LM Direct Event Report due to message size limitations of the SMS protocol. The message format is as follows:

```
!E<mobile ID><Mobile ID Type><sequence no.><time-
tag><latitude><longitude><speed><heading><number
Sats><fix status><carrier><RSSI><78omm.
state><hdop><inputs><unit status><event index><event
code><accums><list of accumulators>
```

The field definitions are as follows. Please note that all fields are ASCII Hex encoded. That is, for a value of 4, the SMS Event report will encode it as 04. A value of 15 would be encoded as 0F.

- **<mobile ID> (8 bytes)**
  This is the Mobile ID of the LMU that originated the SMS message. The Mobile ID is made up of numerical digits and is encoded in this field as packed BCD[17]. The most significant digit is placed in the upper four bits of the first byte. Any bytes not filled by the mobile ID value will contain FF. In the case where an odd number of digits are used, a 0x0F is also used to pad the lower 4-bits of the last byte. For example, a Mobile ID of 9043002123 would appear as 90433002123FFFFF
- **<mobile ID Type> (1 byte)**
  The type of Mobile ID being used by the LMU. The available types are:
  0 – OFF
  1 – Electronic Serial Number (ESN) of the LMU
  2 – International Mobile Equipment Identifier (IMEI) or the Decimal Electronic Serial Number (ESN-DEC) of the wireless modem
  3 – International Mobile Subscriber Identifier (IMSI) of the SIM card. (iDEN and GSM/GPRS devices only)
  4 – User Defined Mobile ID
  5 – Phone Number of the mobile (if available)
  6 – The current IP Address of the LMU
- **<sequence no.> (2 bytes)**
  A 16-bit number used to uniquely identify a message. This number is initialized to 1 on a cold boot and will be incremented each time an inbound message is sent by the LMU. The LMU remembers its current Sequence Number during sleep, though it will eventually rollover from 65535 to 1, skipping zero.
- **<time-tag> (4 bytes)**
  The time tag of the message in seconds, referenced from Jan 1, 1970. This would be the same as the Update Time in an LM Direct Event Report.

[17] Binary-coded decimal

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

- **<time of fix> (4 bytes)**
  The Time of Fix of the GPS position in seconds referenced from Jan 1, 1970. This is the same as the Time of Fix field in an LM Direct Event Report.
- **<latitude> (4-bytes)**
  The latitude reading of the GPS receiver, measured in degrees with a 1x10-7 degree lsb[18], signed 2's complement.
- **<longitude> (4 bytes)**
  The longitude reading of the GPS receiver, measured in degrees with a 1x10-7 degree lsb, signed 2's complement.
- **<speed> (4 bytes)**
  The speed as reported by the GPS receiver, measured in centimeters per second.
- **<heading> (2 bytes)**
  The heading value reported in degrees from true North.
- **<number Sats> > (1 byte)**
  The number of satellites used in the GPS solution.
- **<fix status> (1 byte)**
  The current fix status of the GPS receiver bitmapped as follows:
  Bit 0 – Predicted
  Bit 1 – Differentially Corrected
  Bit 2 – Last Known
  Bit 3 – Invalid Fix
  Bit 4 – 2D Fix
  Bit 5 – Historic
  Bit 6 – Invalid Time
- **<carrier> (2 bytes)**
  The identifier of the Carrier/Operator the wireless modem is currently using.
- **<RSSI> (2 bytes)**
  The received signal strength of the wireless modem in dBm. This value is signed in a 2's complement format.
- **<Comm. State> (1 byte)**
  The current state of the wireless modem bit mapped as follows
  Bit 0 – Available
  Bit 1 – Voice Network Service Found
  Bit 2 – Data Service Found
  Bit 3 – Data Session Connected
  Bit 4 – Not Used
  Bit 5 – Roaming

- **<hdop> (1 byte)**
  The GPS Horizontal Dilution of Precision. It is a unit-less value reported with a 0.1 lsb.

[18] Least significant bit

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

- **<inputs> (1 byte)**
  The current state of the inputs, bit mapped as follows:
  Bit 0 – Ignition
  Bit 1 – Input 1
  Bit 2 – Input 2
  Bit 3 – Input 3
  Bit 4 – input 4
  Bit 5 – Input 5
  Bit 6 – input 6
  Bit 7 – Input 7
- **<unit status> (1 byte)**
  Status of key modules within the unit.
  Bit 0 – Not Used
  Bit 1 – GPS Antenna Status (0=OK, 1=Error)
  Bit 2 – GPS Receiver Self-Test (0=OK, 1=Error)
  Bit 3 – GPS Receiver Tracking (0=Yes, 1=No)
  Bit 4 – Not Used
  Bit 5 – Config Error (0 = No ,1 = Yes)
  Bit 6 – GPS Receiver Exception (0 = OK, 1 = Error)
  Bit 7 – Not Used
- **<event index> (1 byte)**
  The index number of the event that generated the report. A value of 255 represents a Real Time PEG Action request.
- **<event code> (1 byte)**
  The event code assigned to the report as specified by the creating event's Action Modifier.
- **<accums> (1 byte)**
  The number of accumulators being reported with the event report. A maximum of 4 accumulators can be included
- **<list of accumulators> (4 bytes for each entry)**
  A list of from 1 to 4 accumulators being reported with the event report.

Copyright ©CalAmp DataCom Inc 2009

11.1.2 SMS Text Status Message

The Text Status message was designed to help installers or support personnel to easily determine the state of an LMU using SMS. The message contains several key status indicators including Comm Status, GPS Status, Inbound Address and input states. Its format is as follows:

```
APP: <App ID> <Firmware Version>
COM:<RSSI> [./d/D][./a/A][./L][IP address] [<APN>]
GPS:[Antenna <Short/Open/Off>] | [No Time Sync] |
[<FixStatus> <Sat Count>]
INP:<inputs states> <vehicle voltage>
MID:<mobile ID> <mobile ID type>
INB:<inbound IP address>:<inbound port> <Inbound
Protocol (LMD/LMX)>
```

- **APP:**
  - **<App ID>:**
    The Application ID value of the LMU indicating the host platform and the wireless networking technology of the LMU.
  - **<Firmware Version>:**
    The current firmware version in use by the LMU
- **COM:**
  - **<RSSI>:**
    This is the signal strength the wireless modem sees from the network. In general the LMU is at least scanning for the network if the RSSI is not -113.
  - **[./d/D]:**
    If the character 'D' is present, it indicates the LMU had a data session established when it responded to the status request. For the 8-Bit product line an upper case 'D' indicates both the Inbound and Maintenance sockets are ready. The lower case 'd' indicates that only the Maintenance socket is ready. A '.' indicates no sockets are ready.
  - **[./a/A]:**
    This field indicates if the LMU has received an Acknowledgement from the Inbound server. This field will be empty if the LMU has never received an ACK.The lower case 'a' will be present if it has received an ACK since the last cold boot (i.e. power cycle) but not the last warm boot (App Restart or Sleep). The upper case 'A' will be present if the LMU has received an ACK since the last warm boot. A '.' Indicates no acknowledgement has been received.
  - **[./L]:**
    This field indicates if the LMU's log is currently active. An 'L' indicates that the log is currently in use (i.e. one or more records have been stored) where a '.' indicates the log is inactive.
  - **[IP Address]:**
    This is an optional field if and is only present if the LMU has established a

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

valid data session. This field will contain the current IP address of the LMU as assigned by the wireless network. Note that if you see a value of 192.168.0.0, this is an indication that the LMU has not been able to establish a data session.

- **[<APN>]**
  The current Access Point Name in use by a GSM LMU.

- **GPS:**
  - **[Antenna <Short/Open/Off>]**:
    This field, if present, indicates a problem with the LMU's GPS antenna. A value of Short indicates that the antenna cable has likely been crushed. A value of Open indicates that the antenna cable is either cut or disconnected. A value of Off indicates that the LMU' GPS receiver is off.
  - **[No Time Sync]**:
    If this field is present, it indicates that the LMU's GPS receiver has not been able to find even a single GPS satellite. This would likely been seen in conjunction with the above antenna error, or if the LMU GPS antenna is otherwise blocked[19].
  - **[<FixStatus> <Sat Count>]:**
    If these fields are present it indicates that the LMU has, or had a valid GPS solution. The <Sat Count> field indicates how many GPS satellites are currently in use by the LMU. The <FixStatus> field indicates the type of fix. The Fix Status types are detailed in the LM Direct Reference Guide.
- **INP:**
  - **<input states>:**
    This field details the current state of each of the LMU's discreet inputs. This field is always 8 characters long. The left most character represents the state of input 7 where the right most represents the state of input 0 (i.e. the ignition). A value of 1 indicates the input is currently in the high state. A value of 0 indicates it is currently in the low state.
  - **<vehicle voltage>:**
    This field will contain the current reading of the LMU's internal A/D. This will be the supply voltage provided to the LMU in mV.
- **MID:**
  - **<mobile ID>:**
    This will be the current mobile ID in use by the LMU.
  - **<mobile ID type>:**
    This will be the type of Mobile ID in use by the LMU. The available types are, Off, ESN, IMEI, IMSI, USER, MIN and IP ADDRESS.
- **INB:**
  - **<inbound IP address>:**
    This is the current IP address in use by the LMU. This value should match the IP address of your LM Direct server.
  - **<inbound port>:**
    This is the current UDP port the LMU will use to deliver its LM Direct data.

[19] For example you may see this if the vehicle is in a garage when the LMU is powered up.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

This value should match UDP port you are using on your LM Direct server. It is typically 20500.

- **<Inbound Protocol (LMD/LMX)>:**
  This is the current UDP/IP messaging protocol in use by the LMU. In general it should be LMD.

Copyright ©CalAmp DataCom Inc 2009

11.1.3 SMS Text Message

The SMS Test Message feature is a subset of PEG's Short and Long Test Message features. The SMS Text Message therefore also comes in two varieties, a short message, that is 1-15 characters long and a long message that can be 1-63 characters long. The SMS Text Messages will have the following format:

```
<Message>[<Mobile ID>],[<Timestamp>][<CR>][<LF>]
```

- **<Message>:**
  This is the short or long text message to be sent. The message contents are controlled by Parameters 2177 (short messages) and 2176 (long messages)
- **[<Mobile ID>]:**
  This is an optional field. If present it will contain the current Mobile ID of the LMU.
- **[<Timestamp>]:**
  This is also an optional field. If present it will contain the date and time the SMS message was created by PEG.
- **[<CR>]:**
  If this field is present, the SMS message will contain a Carriage Return character.
- **[<LF>]:**
  If this field is present, the SMS message will contain a Line Feed character.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

11.1.4 SMS GPS Status Message

The GPS Status Message allows users to remotely poll the LMU for its current position via SMS. The message is formatted as follows:

```
GPS:<Fix Status> <Satellite Count> <GPS OFF>
LAT:<latitude>
LON:<longitude>
HDG: <heading>
SPD: <speed km/h>, <speed mph>
MID:<mobile id> <mobile ID type>
```

- **GPS:**
  - **[<FixStatus> <Sat Count>]:**
    If these fields are present it indicates that the LMU has, or had a valid GPS solution. The <Sat Count> field indicates how many GPS satellites are currently in use by the LMU. The <FixStatus> field indicates the type of fix. The Fix Status types are detailed in the LM Direct Reference Guide.
  - **[<GPS Off>]**:
    This field, if present, indicates if the GPS receiver is powered off. A value of Off indicates that the LMU' GPS receiver is off.
- **LAT:**
  - **<latitude>:**
    The current (or last known) latitude value provided by the LMU's GPS receiver. The value is in decimal degrees.
- **LON:**
  - **<longitude>:**
    The current (or last known) longitude value provided by the LMU's GPS receiver. The value is in decimal degrees.
- **HDG:**
  - **<heading>:**
    The current (or last known) heading value provided by the LMU's GPS receiver. The value is in degrees from true north.
- **SPD:**
  - **<speed km/h>:**
    The current (or last known) speed value provided by the LMU's GPS receiver. The value is in kilometers per hour
  - **<speed mph>:**
    The current (or last known) speed value provided by the LMU's GPS receiver. The value is in miles per hour.
- **MID:**
  - **<mobile ID>:**
    This will be the current mobile ID in use by the LMU.
  - **<mobile ID type>:**
    This will be the type of Mobile ID in use by the LMU. The available types are, Off, ESN, IMEI, IMSI, USER, MIN and IP ADDRESS.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

11.1.5 SMS Comm Status Message

The Comm Status Message allows users to remotely poll the LMU for its current wireless modem status and settings via SMS. The message is formatted as follows:

```
<RSSI> [./d/D][./a/A][./L] <IP Address> <Local Port>
M:[O/C/E][./s][./r] <Maint URL> <Maint Port>
I:[O/C/E][./s][./r] <Inbound URL> <Inbound Port>
O:[O/C/E][./s][./r] <Outbound URL> <Outbound Port>
```

- **<RSSI>:**
  This is the signal strength the wireless modem sees from the network. In general the LMU is at least scanning for the network if the RSSI is not -113.
- **[./d/D]:**
  If the character 'D' is present, it indicates the LMU had a data session established when it responded to the status request. For the 8-Bit product line an upper case 'D' indicates both the Inbound and Maintenance sockets are ready. The lower case 'd' indicates that only the Maintenance socket is ready. A '.' indicates no sockets are ready.
- **[./a/A]:**
  This field indicates if the LMU has received an Acknowledgement from the Inbound server. This field will be empty if the LMU has never received an ACK.The lower case 'a' will be present if it has received an ACK since the last cold boot (i.e. power cycle) but not the last warm boot (App Restart or Sleep). The upper case 'A' will be present if the LMU has received an ACK since the last warm boot. A '.' Indicates no acknowledgement has been received.
- **[./L]:**
  This field indicates if the LMU's log is currently active. An 'L' indicates that the log is currently in use (i.e. one or more records have been stored) where a '.' indicates the log is inactive.
- **<IP Address>:**
  This is an optional field if and is only present if the LMU has established a valid data session. This field will contain the current IP address of the LMU as assigned by the wireless network. Note that if you see a value of 192.168.0.0, this is an indication that the LMU has not been able to establish a data session.
- **<Local Port>:**
  This field contains the current Local Port Number in use by the LMU. Typically this value is set to 20510 via Parameter 774.

- **M/I/O:**
  The first character of each line indicates which socket the status indicates apply to. The three lines are M = Maintenance Socket, I = Inbound Socket, O = Outbound Socket.
  - **[O/C/E]:**
    This field indicates the current status of the referenced socket. The three possible states are, OPEN (O), CLOSED (C) or ERROR (E).

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

- **[./S]**
  This field indicates if the LMU has sent data thru the referenced socket. An 'S' indicates data has been sent. A '.' indicates no data has been sent.
- **[./R]**
  This field indicates if the LMU has received data thru the referenced socket. An 'R' indicates data has been received. A '.' indicates no data has been received.
- **<URL>:**
  The current URL associated with the referenced socket. Please note that the URL is truncated to 18 characters in length.
- **<Port>:**
  The current UDP Port associated with the referenced socket. In each case this should be the port on the remote server used for LMU communications.

Copyright ©CalAmp DataCom Inc 2009

11.2 SMS Request Messages

There are two formal types of request messages than can be sent to an LMU and one informal type. The formal types, which are Unit Requests and Parameter Requests messages, generally elicit an SMS response from the LMU. The informal type, AT Commands, does not. The formatting and use of each is detailed in the following sections.

11.2.1 Unit Request Messages

The Unit Request messages are designed to produce specific responses or actions from an LMU. They are of the format "!R<#>" where <#> is a number from 0 – 9. The available Unit Request messages are as follows.

Request a Text Status Message:

```
!R0<Rddddddddddd>
```

This SMS message will force the LMU to return a Text Status message to the originating mobile. If the Rddddddddddd string is included, the Text Status message is redirected to the phone number indicated by ddddddddddd.

Parameter Write Request

```
!R1 <parameter write string>
```

This request allows the equivalent of an AT$APP PARAM command to be initiated remotely via SMS. The <parameter write string> should match the format of the AT$APP PARAM command. That is, it should contain a CSV string containing the Parameter ID, the Parameter Index and one or more values depending on the Parameter ID. No response is sent back to the originating mobile.

Request a Real-Time PEG Action

```
!R3,<Action Code>,<Action Modifier>
```

This SMS message will force the LMU to perform the Action indicated by the <Action Code> and <Action Modifier> fields. For a list of all available Actions please refer to the PEG Programming Guide.

Request an SMS Event Report

```
!R4
```

This request will force the LMU to send an SMS Event Report to the originating mobile.

Request a GPS Status Report

```
!R5
!RG
!Rg
```

This request will force the LMU to send an SMS GPS Status Message to the originating mobile.

Software Update Request

```
!R8 <new version number> [<URL of server>]
```


Copyright ©CalAmp DataCom Inc 2009

This request only applies to the LMU-1000. It will cause the LMU-1000 to initiate a software update from a server via HTTP.

The <new version number> is the 3-character version designation of the software to be downloaded (e.g. 12a). The LMU software should combine this version with the current App ID to build a file name for the update it is seeking to download. The format for the filename is: LMU_<AppId>_<version>.jar (i.e. 'LMU_086_12a.jar').

The "URL of server" refers to the server from which the LMU requests the download. This is an optional field which should default to URL of the Maintenance Server (i.e. PULS) if left blank, or if the requested URL is unreachable.

Reprogram the SMS Inbound Address

`!R9<S|C><ddddddddddd>`

This SMS message will change the SMS Inbound address to match the phone number of the originating mobile. This setting is cleared on a power cycle.

If the C option is included, the SMS Inbound address is reset to a null string.

If the S option is included, the address change is saved to memory (i.e. a power cycle does not clear the SMS Inbound value to null)

If the <ddddddddddd> option is included, the SMS Inbound Address is change to the <ddddddddddd> string. This value is also saved to memory and will be retained through a power cycle.

Request a Comm Status Report

`!RC`

This request will force the LMU to send an SMS Comm Status Message to the originating mobile.

11.2.2 SMS Parameter Message

The SMS Parameter message is an augmentation of the !R1 request. It allows users to both write and read LMU Parameter values remotely. The basic format is as follows:

```
!P<id><action><msg body>
```

The fields of the message are:

- **<id>**
  A transaction ID used by server to match up response to request (4-bytes, ASCII-Hex encoded)
- **<action>**
  The Parameter Action type (1 byte, ASCII-Hex encoded)
  0=Read Request
  1=Write Request

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

2=Read Response
3=Write Response
255=Error

- **<msg body>**
  This field will be the list of parameters needed to comply with the <action>. This field can be of variable length and is ASCII-Hex encoded. The exact format will match the contents of the LM Direct Parameter message starting below the action byte. Please refer to the LM Direct Reference Guide for details.

11.2.3 Serial Message Request

The SMS Serial Message Requests allow a user to send an SMS message to the LMU and have the payload of that message passed-thru to a serial device on the LMU's host port. This feature is only available while the host port is in AT Command mode or, for the LMU-4100, in MDT mode.

Send just payload to serial device:

`!S0<payload>`

This SMS message will force the LMU to send the <payload> contents to any device connected to its host port.

Append <CR>+<LF> to payload

`!S1<payload>`

This SMS message will force the LMU to send the <payload> contents to any device connected to its host port. The Carriage Return and Line Feed characters will be appended to the end of the <payload>.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

12 CalAmp LMU Interface – TAIP

The Trimble ASCII Interface Protocol (TAIP) is a Trimble-specified digital communication interface based on printable ASCII characters. TAIP was designed specifically for vehicle tracking applications using the Trimble asset tracking products. It has, however, been expanded upon by several companies to meet the needs of their specific devices. The CalAmp LMU-4100 is included among these devices. TAIP supports both scheduled and polled responses.

Only the LMU-4100™ and LMU2500™supports the TAIP interface.

12.1 TAIP Sentences

12.1.1 General Sentence Structure

All TAIP communications use printable, uppercase ASCII characters. The interface provides a means to configure the LMU to output various sentences in response to queries or on a scheduled basis. Each TAIP sentence has the following general format:

```
>ABB{C}[;ID=DDDD][;*FF]<
```

- **>**
  This character represents the start of a TAIP sentence.
- **A**
  Message Qualifier. The Message Qualifier describes the action to be taken on the message. The LMU supports the following qualifiers:
  - The 'Q' qualifier can be used at any time the TAIP interface is active to query for the report messages (i.e. '>QPV<',r '>QLN<' or '>QIO<').
  - The 'F' qualifier is used to command the TAIP interface to report the specified reporting message at the interval specified. For example, '>FPV00300000<' commands the LMU to report a 'PV' message every 30 seconds. The epoch field in the 'F' qualified sentence is not supported and is ignored.
  - The 'D' qualifier is used to command the TAIP interface to report the specified reporting message at the distance, maximum interval and minimum interval specified. For example, '>DPV00100000020000060<' commands the LMU to report a 'PV' message every 60 seconds or 200 meters but not any more often than every 10 seconds. The epoch field in the 'D' qualified sentence is not supported and is ignored.
  - The 'R' qualifier indicates that the sentence is the either the LMU's automatic report or response to a query.
- **BB**
  Message Identifier. The message identifier represents the type of message. The CalAmp LMU currently supports the LN, PV and IO sentences. Please see the sections below for the details on each.
- **{C}**
  Message Body. A data string composed of one or more fixed length fields. The

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

data string is comprised of any printable ASCII characters with the exception of the '>', '<', and ';' characters which are used as delimiters. Field separators, including commas and spaces, are not part of the messages unless otherwise specified. Strings generally use fixed-length fields although some sentences use comma or semicolon delimiters. The message qualifier and the message identifier determine the format and length of the data string.

- **;**
  Field Separator. The semi-colon is used to separate optional fields that may appear after the main sentence.
- **ID=DDDD**
  Vehicle ID. The vehicle ID is a 4 character (DDDD) user defined string used to uniquely identify an LMU. Please note that this ID has no relationship to the User Defined Mobile ID type.
- ***FF**
  Checksum. A checksum expressed in ASCII representation of an eight-bit hexadecimal value.

12.1.2 PV (Position Velocity) Sentence Structure

The general structure for the message body of a PV sentence is as follows:

```
PVAAAAA±BBCCCCC±DDDEEEEEFFFGGGHI
```

Format	Units	Range	Description
PV	NA	NA	PV Message Identifier
AAAAA	Seconds	0-86399	GPS Time of Day Starting at 00:00:00 GMT
±BBCCCCC	Dec Deg	00.00000 – 90.00000	Latitude to 5 decimal places
±DDDEEEEE	Dec Deg	000.00000 – 180.00000	Longitude to 5 decimal places
FFF	MPH	0 – 999	Horizontal Speed
GGG	Deg	0 – 359	Heading
H	NA	0 = 2D GPS 1 = 3D GPS 9 = Unknown	Fix Status
I	NA	0 = No Fix 1 = Last Known 2 = Real-time	Age of Fix

12.1.3 LN (Long Navigation) Sentence Structure

The general structure for the message body of a LN sentence is as follows:

```
LNAAAAABBB±CCDDDDDDD±EEEFFFFFFF±GGGGGGHHIIIJ±KKKLMMMNO
O{PPQQ}RRRRRRRRRST
```

Format	Units	Range	Description
LN	NA	NA	LN Message Identifier
AAAAABBB	Seconds	00000.000 – 86399.999	GPS Time of Day Starting at 00:00:00 GMT
±CCDDDDDDD	Dec Deg	00.0000000 –	Latitude to 7 decimal places

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

		90.0000000	
±EEEFFFFFFF	Dec Deg	000.0000000 – 180.0000000	Longitude to 7 decimal places
±GGGGGGHH	Feet	000000.00 – 999999.99	Altitude relative to mean sea level
IIIJ	MPH	000.0 – 999.9	Horizontal Speed
±KKKL	MPH	000.0 – 999.9	Vertical Speed
MMMN	Deg	000.0 – 359.9	Heading
OO	NA	00 – 32	Number of Satellites Used
PP	NA	01 – 32	Satellite ID
QQ	NA	00 – FF	IODE (2 digit hex)
RRRRRRRRRR	NA	‘ ‘	Reserved, generally set to a space
S	NA	0 = 2D GPS 1 = 3D GPS 9 = Unknown	Fix Status
T	NA	0 = No Fix 1 = Last Known 2 = Real-time	Age of Fix

12.1.4 IO (Input / Output) Sentence Structure

The general structure for the message body of a IO sentence is as follows:

```
IOAABBCCDD
```

Format	Units	Range	Description
IO	NA	NA	IO Message Identifier
AA	NA	00 or FF	00 = Ignition Off FF = Ignition On
BB	NA	00 or FF	00 = Input 1 Low FF = Input 1 High
CC	mV	00 – FF	A/D 0 Reading
DD	NA	00 or FF	00 = Output 0 Cleared FF = Output 0 Set

12.1.5 Optional Fields

The CalAmp LMU implementation of TAIP offers a several optional fields which can be appended to the end of a TAIP message but before the ‘<’ character. Each field will be separated by a semi-colon (;).and will appear at the end of a sentence in the following order:

- TAIP Vehicle ID
- Event Code
- Input States
- Accumulator Values
- Checksum

12.1.5.1 TAIP Vehicle ID

The TAIP Vehicle Identification (ID), consists of four numeric characters which may be optionally tagged to all inbound messages. This allows the receiving application to

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

distinguish which unit is reporting. If the Vehicle ID is included, it is delimited with a semicolon.

```
;ID=AAAA
```

The default setting is: ID set to "0000"

To include the vehicle ID in a TAIP sentence, you would use the TAIP Enables parameter (2048). Bit 1 controls the presence of the Vehicle ID. If this bit is set, then the ID is included. If it is cleared, it is omitted.

The Vehicle ID is controlled by Parameter 2050. Each of the four indices of this parameter map to a single ASCII character of the ID string. Index 3 maps to the least significant digit and index 0 maps to the most significant digit. The value should be the decimal representation of the desired character. Valid values range from 48 to 57

As an example, to include a vehicle ID value of 9450 with each TAIP sentence you would use the following five commands:

Set the LMU to include the TAIP Vehicle ID:

```
AT$APP PARAM 2048,0,2,2
```

Configure the vehicle ID:

```
AT$APP PARAM 2050,0,57
AT$APP PARAM 2050,1,52
AT$APP PARAM 2050,2,53
AT$APP PARAM 2050,3,48
```

12.1.5.2 Event Code

TAIP sentence may include an optional Event Code. This is generally used when TAIP messages are generate by means of a PEG script as opposed to querying or scheduled reporting.

The extension's format is as follows:

```
EV=XXX
```

The event code may range from 0 to 149 or 255. A value of 255 is used to indicate that the TAIP sentence was generated by a Real-Time PEG Action, a query request or a scheduled report. Only a PEG script generated message will contain Event Codes 0-149.

To include the Event Code with a TAIP sentence, you would use bit 6 of the TAIP Enables Parameter. If this bit is set, the Event Code is included, if it is cleared, the Event Code is omitted. To include the event code you would use the command:

```
AT$APP PARAM 2048,0,64,64
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

To omit the event code you would use:

```
AT$APP PARAM 2048,0,64,0
```

12.1.5.3 Input States

TAIP sentences may include an optional Input State extension, the format of which is:

```
IN=XXX
```

The value of XXX may range from 0 – 255. Each bit of XXX represents a different input. If the bit is set, the input is in the high state, if it is cleared, the input is in the low state. The bit-mapping for the inputs is as follows:

- Bit 0 = Ignition
- Bit 1 = Input 1
- Bit 2 = Input 2
- Bit 3 = Input 3
- Bit 4 = Input 4
- Bit 5 = Input 5
- Bit 6 = Input 6
- Bit 7 = Input 7

Inclusion of the input extension is controlled by bit 7 of the TAIP Enables Parameter. To include the inputs you would use:

```
AT$APP PARAM 2048,0,128,128
```

To omit the inputs you would use:

```
AT$APP PARAM 2048,0,128,0
```

12.1.5.4 Accumulator Values

Any TAIP sentence can optionally include the values of the first 4 Accumulators (acc 0 – 3). Each value is separated by a comma. The format of this extension is as follows:

```
AC=<acc_00>,<acc_01>,<acc_02>,<acc_03>
```

Each Accumulator Value <acc_xx> may range from 0 to 4294967296.

The Accumulator extension is included if bit 7 of the TAIP Message Selection Parameter (ID 2049) is set. For example, to include the Accumulator Values, you would use the command:

```
AT$APP PARAM 2049,0,128,128
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

12.1.5.5 Checksum

Checksums are useful in detecting data transmission errors when the communication channel is noisy. If provided, they are delimited from the rest of the sentence by a semicolon and are always the last element of the sentence before the end delimiter.

```
;*AA<
```

The default mode of operation is to include checksums in sentences from the module. The checksum itself is a two-byte ASCII representation of an eight-bit hexadecimal value. The checksum is computed as the eXclusive Or (XOR) of all characters from the beginning of the sentence (including the start delimiter) up to and including the asterisk (*) character in the checksum protocol element. The LMU will accept all messages with a correct checksum or with the checksum element omitted. Messages sent to the module with an incorrect checksum will be disregarded.

The presence of the check sum is controlled by bit 0 of the TAIP Enables Parameter. To include the checksum you would use:

```
AT$APP PARAM 2048,0,1,1
```

To omit the checksum, you would use:

```
AT$APP PARAM 2048,0,1,0
```

12.2 TAIP Settings

12.2.1 Enabling TAIP

The LMU-4100's TAIP interface can be enabled and disabled, which differs from both the LM Direct and SMS interfaces which are always on. In order for the LMU-4100 to create and process TAIP messages, it must be enabled. This is done with bit 3 of the Service Enables Parameter. To turn the TAIP interface on you would use:

```
AT$APP PARAM 1025,0,8,8
```

To disable the TAIP interface, the AT Command would be:

```
AT$APP PARAM 1025,0,8,0
```

If the TAIP interface is not enabled, the LMU-4100 will neither response nor react to any incoming TAIP sentences, nor will it creates any sentences based on its reporting intervals.

12.2.2 Message Selection

As mentioned above, the LMU-4100 supports 3 TAIP sentences, LN, PV and IO. The lower three bits of Parameter 2049 control which sentences will be created. If a bit is set, then the associated sentence will be created as an automatic or PEG generated report. If the bit is cleared, then the associated sentence will not be created. The bit mappings are as follows:

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

- Bit 0 = Enable / Disable the PV sentence
- Bit 1 = Enable / Disable the LN sentence
- Bit 2 = Enable / Disable the IO sentence.

For example, to turn on all three messages you would use:

```
AT$APP PARAM 2049,0,7,7
```

To turn off just the LN message you would use:

```
AT$APP PARAM 2049,0,2,0
```

Note that the query (Q), frequency (F) and distance (D) qualifiers may be used with any of the message types regardless of the settings of this Parameter.

12.2.3 Message Destination

The LMU-4100 delivers its TAIP sentences over UDP/IP. In order to accomplish this it needs both a Remote IP Address and Remote Port. The IP Address is controlled by Parameter 2052 and the Port is controlled by Parameter 2053. Both values are defaulted to 0. As an example, say you wish to deliver TAIP sentences to IP a.b.c.d on port 21000. You would use the following two commands to accomplish this:

```
AT$APP PARAM 2052,0,a.b.c.d
AT$APP PARAM 2053,0,21000
```

12.2.4 Local Port

The Local Port is the UDP Port number the LMU-4100 listens on for incoming TAIP messages (i.e. sentences with the Q, F and D qualifier). It is defined by Parameter 2051 and is defaulted to 21000.

12.3 TAIP Reporting

The TAIP interface supports two types of scheduled reporting, Standard and Directed. Directed Reporting is active when bit 5 of the TAIP Enables Parameter (2048) is set. If bit 5 is cleared, then Standard Reporting mode is in effect.

To enabled Directed Reporting you would use:

```
AT$APP PARAM 2048,0,32,32
```

To enable Standard Reporting you would use:

```
AT$APP PARAM 2048,0,32,0
```

Scheduled reporting is implemented using Time-Distance Profile 0. Whenever a 'D' or 'F' qualifier is received through the TAIP interface, the LMU will program index 0 of

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Parameters 263 and 262 respectively (i.e. the Time-Distance Distance and Time-Distance Time Parameters). Receipt of 'F' and 'D' qualifiers will also automatically start Time-Distance profile 0. It is important to remember that this will override any existing PEG Time-Distance activities. Conversely, any subsequent PEG Time-Distance activities will override the TAIP 'D' or 'F' settings.

The selected TAIP sentences will be sent to the Remote IP Address and Remote Oort whenever a Time-Distance Update Trigger occurs.

12.3.1 Scheduled Reporting – Standard Mode

Standard Reporting is initiated by sending a 'D' or 'F' qualifier message for the desired reporting message type ('PV', 'LN', 'IO') to the LMU. Standard Reporting messages are sent to the address of last UDP packet received on the TAIP Listening Port. Standard Reporting will cease when the LMU is reset or when the TAIP interface receives a null message ('><'). Reporting does not resume until a new incoming qualifier is received.

12.3.2 Scheduled Reporting – Directed

Directed Reporting does not rely on receiving an initiation message from an outside source to begin operation. Once initiated, it will remain operational even after a reset or power cycle of the LMU. To initiate Directed Reporting mode the following Parameters must be programmed:

- TAIP Directed Reporting enabled (2048) – Bit 5 must be set
- Remote IP Address (2052) and Remote Port (2053) – Should be set to the public IP address of your TAIP server
- Message Selection (bits 0- 2 of 2049) – At least one type of TAIP sentence must be enabled. Note that this can also be accomplished by using the 'D' or 'F' qualifier.

Like Standard Reporting, Directed Reporting can be disabled by sending a null message ('><') to the LMU's TAIP Listener Port. Receipt of a null message will zero out the TAIP Message Select Parameter (2049). Directed Reporting can be resumed by sending a 'D' or 'F' qualifier message or by setting the appropriate bits in the TAIP Message Select Parameter.

12.3.3 PEG Reporting

If you wish to create a TAIP sentence in response to a PEG Trigger other than a Time-Distance update, you would use the Send TAIP Report PEG Action within your PEG Script. This Action will create the sentences selected in Parameter 2049 and send them to the Remote IP Address and Port. Please note that both the TAIP interface and directed reporting must be enabled for this PEG Action to work.

12.3.4 SMS Reporting

SMS reporting technically is not part of the TAIP interface, but does use some of its settings. By setting bit 6 of Parameter 2049 the LMU will forward the contents of any SMS message received to the TAIP Remote Address and Port. To enable this feature, you would use:

```
AT$APP PARAM 2049,0,64,64
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

To disable it, you would use:

```
AT$APP PARAM 2049,0,64,0
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

13 LMU Maintenance

13.1 Mobile ID

The Mobile ID is intended to be a unique identifier that would allow a remote application to identify which LMU sent an incoming message The Mobile ID is contained within the options header of an LM Direct message and is normally tagged on each message created by the LMU.

Users have several options on what value can be used for the Mobile ID. They are as follows:

- The serial number of the LMU (i.e. the ESN)
- The serial number of the Modem (IMEI for GSM and iDEN and ESN-Dec for CDMA)
- The IMSI assigned to the SIM Card
- A user defined value (1 to 15 digits long)
- The phone number of the modem (when available)
- The IP address assigned to the modem (this is only useful when in a static IP addressing environment)

The selection of which value is used as the Mobile ID is controlled by S-Register 145. The available settings are:

0 = OFF/ No Mobile ID
1 = the Electronic Serial Number of the LMU (ESN)
2 = the serial number of the Modem (IMEI for GSM and iDEN devices, the ESN-Dec for CDMA devices)
3 = the subscriber identifier (IMSI for GSM and iDEN, the IMSI_T for CDMA)
4 = User Defined
5 = Phone Number
6 = IP Address

For instance, to change the Mobile ID to be the serial number of the modem, you would use:

```
ATS145=2
```

Both the User Defined and Phone Number Mobile IDs can be programmed by the user. The one exception here is in the CDMA LMU which can only be programmed with a User Defined Mobile ID value. The phone number is programmed into the LMU's CDMA modem and thus is always available.

To program the User Defined mobile ID, you would use:

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

```
AT$APP Param 2304,0,<User Value>
```

To program in a phone number, you would use:

```
AT$APP PARAM 2305,0,<phone number>
```

Both the user defined Mobile ID and phone number fields must be all digits. That is, they cannot contain spaces, brackets or dashes.

The default setting is to have the ESN as the Mobile ID.

13.2 Firmware Versioning

The firmware version of an LMU is broken into two parts, an application ID and the actual firmware revision. The application ID is a 3 digit value that indicates the type of LMU (8-Bit products (MTU-100™, LMU-900™, LMU-1100™, LMU-1200™LMU-1000™, LMU-2500™ or LMU-4100™) and what technology is in use (GSM, CDMA or iDEN). The firmware revision is made up of a major version, a minor version and a release version. The major and minor versions range from 0 to 9 where the release version ranges from a thru z. the firmware revision has the format of X.Yz where X is the major version, Y is the minor version and z is the release version.
The firmware version can be read via AT command using:

```
ATI0
```

The firmware version is also available in PULS for units that are managed via that system.

13.3 Configuration Versioning

The Configuration Versioning of the LMU is broken into two values, the Script Version and the Configuration Version. The Script Version is intended to represent a fixed set of features within a PEG script where the Configuration Version is meant to represent the settings within that PEG Script. For instance, the Script Version would indicate that the PEG Script has a speeding detect feature. The Configuration Version would indicate the speed limit of 65MPH.

The Script Version can be accessed using S-Register 121. The Configuration Version is access using S-Register 143. Please keep in mind that PULS uses these two S-Register as part of its configuration management features. It is there for unadvisable to change these values outside of PULS.

There is a user controlled configuration version known as the Vehicle Class. This version number is controlled by S-Register 147. Users may use this version to represent whatever they need (for instance a customer ID). This value is displayed within PULS, but it is not used for any specific purposes.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

13.4 Downloading Firmware

In some cases it may be necessary to upgrade the firmware of an LMU. The two main reasons for performing a firmware upgrade are the addition of a new feature or a bug fix. This section details how firmware updates can be performed on an LMU.

13.5 Downloading Firmware – Locally

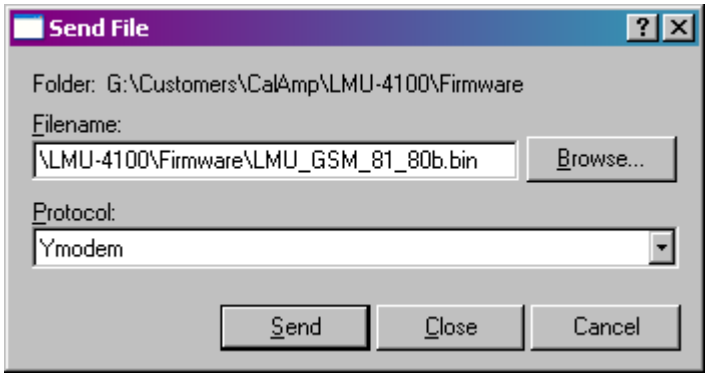
Local firmware downloads are done from a laptop connected serially to the LMU. It is recommended that firmware upgrades be performed via a wired connection (i.e. not over Bluetooth) as any loss of communications during a firmware download may render the LMU inoperable.

Each type of LMU has a slightly different procedure to upgrade its firmware.

13.5.1 Local Firmware Upgrade

Most LMUs use the Ymodem protocol to upgrade its firmware. The only exception is the LMU-1000™ product. These instructions assume access to the HyperTerminal application. It may be possible to upgrade firmware via other applications, but they are not currently supported by CalAmp.

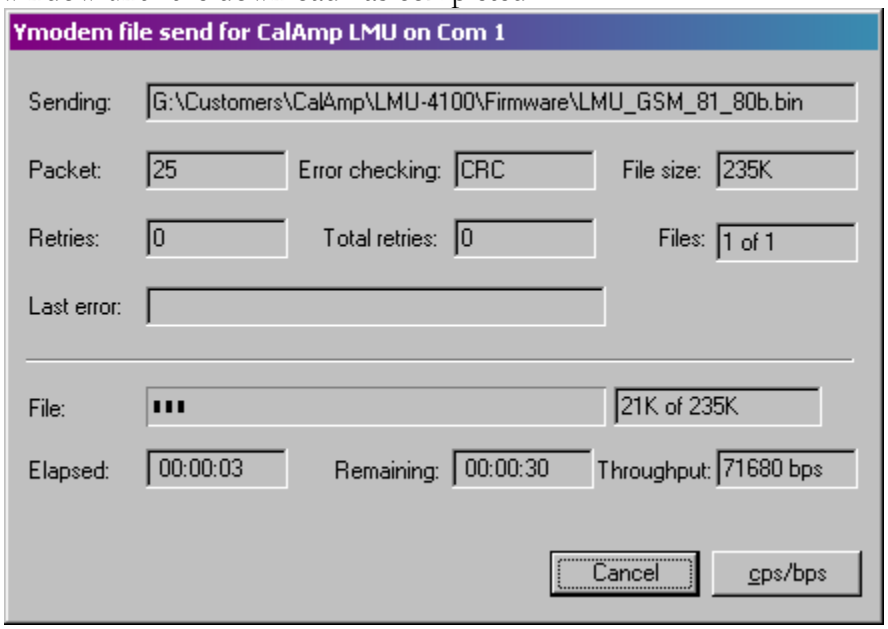
1. Open the LMU HyperTerminal session. To create this session please refer to Appendix D
2. Issue the AT Command
   `ATDNLD`
   The following response should appear:
   `ReadWaiting for the file to be sent ... (press 'a' to abort)`
3. From the **Transfer** menu click **Send File…**
4. Click the **Browse** button and locate the firmware file to be downloaded. Be advised that firmware files are technology specific. That is, only GSM firmware should be loaded on GSM LMUs. The file format should look similar to:
   `LMU_<technology>_<app>_<firmware rev>.bin`
   `LMU_GSM_81_80b.bin`



Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

5. Click the **Send** button. This should bring up a progress window. DO NOT close this window until the download has completed.



6. The following message should appear in the HyperTerminal window when the download completes:

```
Transfer Completed Successfully!
--------------------------------
 Name: LMU_GSM_81_80b.bin
 Size: 239824 Bytes
--------------------------------
```

13.5.2 Local Firmware Upgrade – LMU-1000™

The LMU-1000™ should be upgraded remotely as a serial connection into the device is not typically available.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

13.6 Downloading Firmware – Remotely

Remote firmware downloads for the LMU products are managed by the PULS™ system. Please refer to the PULS Users Guide for details.

13.6.1 Remote Firmware Upgrade – LMU 1000™

The LMU-1000™ can be forced to do a remote firmware upgrade by use of an SMS Message. The message is formatted as follows:

```
!R8 <new version number> [<URL of server>]
```

The "new version number" is the 3-character version designation of the software to be downloaded

The [<URL of server>] refers to the server and file which the LMU requests to download. This is an optional field which will default to URL of the Maintenance Server (Parameter ID 2320, Index 0). The filename should combine the version with the current App ID to build a file name for the update it is seeking to download. The format for the filename is: LMU_<AppId>_<version>.jar (i.e. 'LMU_086_12a.jar').

The complete command would look similar to the following:

```
!R8 03d http://puls.calamp.com/dnld/lmu-086-03d.jar
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

14 LMU Programming Examples

In this section we detail out three examples solutions using the LMU. Keep in mind that these are fictitious scenarios designed to highlight certain features of the LMU. In the examples, will be referring to the city of Hagensville in the state of Hagen. Hagensville is not modeled after anywhere in particular, but it does have the unique feature of housing all the services we wish to demonstrate. It is also in a country where the metric system is used. Any resemblance to existing applications or locations is purely coincidental.

Each example will be broken into three parts, the customer requirements, including some relevant background information, the solution proposal, and the setup of the LMU.

For the proposal and setup pieces we will further break things down into 3 pieces, a Remote Application, a Local Application, and the CalAmp LMU itself. We will use this breakdown as a means to organize the customer's requirements.

The Remote Application is intended to be your solution which includes some measure of LM Direct implementation. In describing the Remote Application we will simply list the high-level customer features it is going to support. We will not go into any implementation details as that is beyond the scope of this document.

The Local Application will receive a little more focus than the Remote. The Local Application descriptions will deal with hardware selection and what peripherals may be needed by the LMU.

For the LMU piece, this manual will focus on the setup items that would be needed for the application, but are not part of the PEG Script. The corresponding PEG Script is described in the PEG Programming Guide.

All programming examples will make use of AT Commands, though applications such as LMU Manager and PULS would also be usable for these purposes.

The examples focus on the LMU-4100™ and LMU-1000™ as the most flexible and least flexible products available from CalAmp.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

14.1 LMU Programming – Delivery Fleet

14.1.1 Project Overview

Hagensville Express Delivery is the leading local courier service; however they have started to experience some loss of business due to larger competitors. They are looking to make improvements to their services specifically focusing on vehicle and driver efficiency. This will include route optimization, in-vehicle driving directions, and the addition of real-time dispatch. They wish to add a GPS device to their vehicles to facilitate these improvements. They are specifically looking for a device that has the following features:

- Real-Time messaging between the dispatch centers and the drivers
- In-vehicle navigation
- Reporting based on driver and vehicle for time in route, and time at delivery point.
- Tracking for packages delivered and the packages currently on the vehicle.

Hagensville Express Delivery already has an existing relationship with the local iDEN operator and will be handling the airtime accounts for the GPS device.

14.1.2 Project Proposal

14.1.2.1 CalAmp LMU Requirements

The first choice that customers typically make for the LMU will be the technology choice (i.e. GSM, iDEN or CDMA). In this case the choice is especially easy since there is an existing relationship with the iDEN operator. For the purposes of this example we will use the iDEN LMU, though a TetheredLocator solution using an iDEN phone is also possible.

Our next step is to decide what peripheral devices we are going to need to support the Local Application. In this case there are three general requirements

- We need something that can send and receive dispatch messages
- We need a bar code scanner to track packages
- We need something that can run an in-vehicle navigation application

Doing a little research we find that a single Windows Mobile™ based device might be able to meet all three functions[20]. As an additional feature, we want to support Bluetooth connectivity, so we can use the CalAmp BTA.

The last piece on the hardware side is to decide what measure of I/O we need. Based on the customer's requirements (i.e. that they want basic vehicle tracking with no other sensors/driver feedback) it seems all we need is Ignition Sense. This means we can definitely use the CalAmp BTA.

[20] The Motorola MC9090-K Handheld Mobile Computer would be an example.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

14.1.2.2 Local Application Requirements

We are going to host the Local Application on the handheld mobile computer we selected above. Since the device is Windows Mobile™ based so we have a variety of off the shelf software to choose from. Specifically we elect to purchase the In-Vehicle Navigation Software.

We decide to build the bar-code scanner and dispatch messaging piece ourselves. Indeed, this would allow us to put the scanned data as part of the dispatch messaging, hopefully cutting some of the development time. This latter application will use Dial-Up Networking to pass data through the LMU.

To support both applications, the Windows Mobile™ device will need to connect to the GPS port and Dial-Up Networking port of the LMU's BTA.

The Local Application will send messages in the following situations:

- When the application is first started
- When a bar code is scanned
- When the driver needs to send a message

We are glossing over the details of this application. For the purposes of this document, we simply need to know what the application does, not how it does it.

14.1.2.3 Remote Application Requirements

Like the Local Application, we are going to be somewhat vague on the requirements to keep within scope on this document. To that end, the Remote Application must be able to do the following:

- Receive LMU Event messages from the LMU. This includes differentiating between Event Codes.
- Acknowledge messages sent from the LMU
- Open a TCP listener and receive data from the Local Application
- Acknowledge data received from the Local Application
- Display both the LMU and Local Application data to the end user (e.g. a dispatcher)
- Provide a means for the end user to input new data such as new instructions for a given driver or vehicle

The Remote Application would also typically include some measure of reporting engine. This could include things like maintenance schedules, delivery status, vehicle availability, etc…

14.1.3 LMU Setup – Planning

There are really two steps in setting the LMU up for an application. First deciding where data is to go and in what format, and second, what peripherals are in use.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

For this example, the data will be in the LM Direct format[21] which will be sent to your production server and, on the peripheral front, we will be using the CalAmp Bluetooth Adapter using GPS and Dial-Up Networking.

14.1.4 LMU Setup – Development

14.1.4.1 Setting up the Inbound Address

Typically the first step in any setup is to program the LMU with the Inbound Address of your LM Direct server. In this case we are going to assume we have an LM Direct server at a hosting center using the IP address of 172.90.80.241. We have gone one step further and set up a URL that will point this customer's LMU's to this IP address. The URL is "HED.HSIInc.com".

Our first two setup commands therefore are:

```
AT$APP INBOUND 172.90.80.241:20500
AT$APP PARAM 2319,0,"HED.HSIInc.com"
```

14.1.4.2 Outputting NMEA data

The Local Application collects its GPS data via NMEA messages. Specifically the application needs the GGA and RMC messages as a minimum. To enable these messages you would set bits 0 and 4 of S-Register 128, thus our next setup command is:

```
ATS128=17
```

Alternatively we could have done this via Parameter masking using:

```
AT$APP PARAM 1024,8,1,1
AT$APP PARAM 1024,8,16,16
```

We also want to make sure the performance of the GPS receiver is going to be as accurate as possible. For this reason we want to make sure SBAS support is enabled. SBAS support is controlled by bit 4 of S-139 and would give the command of:

```
AT$APP PARAM 1024,19,16,16
```

The last thing we want to look up is the update rate. In this case we are going to be running multiple applications over an 'unreliable[22]' connection so we want to minimize the amount of data being processed. This would push us to use the 1Hz update rate instead of 4Hz. The update rate is controlled by bit 7 of S-139. The command to set the LMU to 1Hz updates would be:

```
AT$APP PARAM 1024,19,128,128
```

[21] It's rare that it's not.
[22] It's common to refer to most wireless links as 'unreliable' due to the increased effect over interference when compared to wired connections.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

14.1.4.3 Configuring the Bluetooth Adapter

On the Bluetooth adapter side we need to do the following:

- Set the BTA to act as a host port to allow Dial Up Networking and GPS NMEA message access
- Set to BTA to be discoverable so the Window Mobile device can connect to it.
- Set up the BTA for Dial Up Networking
- Set the BTA for low security mode to make subsequent pairings from the Windows Mobile device easier. The low security mode setting will allow the PDA to automatically connect to the BTA after the first time the two devices are paired. If we left high security modem enabled, the PDA would force the user to re-enter the Bluetooth PIN and possibly re-build the connection profile every-time they wished to connect to the BTA.

All of these features are controlled by S170.
For the host port we would set bits 0 and 1 to 01.
To allow the BTA to be discovered we would set bit 2.
For Dial-Up Networking support, we need to set bit 4 and finally, for low security mode, we would set bit 5. This would give us the following command:

```
ATS170=53
```

Again we could have accomplished this via Parameter masking using:

Configure the BTA as a Host Port:

```
AT$APP PARAM 1024,50,3,1
```

Configure BTA as discoverable

```
AT$APP PARAM 1024,50,4,4
```

Configure the BTA for Dial-Up Networking support

```
AT$APP PARAM 1024,50,16,16
```

Configure the BTA for low security mode

```
AT$APP PARAM 1024,50,32,32
```

Optionally we can also look at setting the BTA's PIN. This will give us some measure of security on the BTA without creating a potential hassle for the driver. In this case we elect to use the last 4 digits of the LMU's serial number as the PIN. For our first device this happens to be 9848. The BTA's PIN would therefore be setup using:

```
AT$APP PARAM 2081,0,9848
```

Of course the one downside to setting a PIN is the initial setup of each LMU is a bit of a hassle.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

14.1.4.4 Configuring the LMU for Dial-Up Networking

When a user is connected to any device that supports Dial-Up Networking, they are generally concerned about one thing, speed. Unfortunately in this case they are using iDEN devices, so the maximum thru-put that can be expected is around 10kbps. For this reason we are going to want to block as much traffic as possible using the Remote Host IP Address list. Specifically we want to limit access to just the servers at our office and the servers at our data center. The IP range used by the office is 166.143.185.65 thru 166.143.185.90 and the IP range used by the data hosting facility is 172.90.80.240 thru 172.90.81.50[23].

To set up an appropriate access list we would use the following commands:

```
AT$APP PARAM 1282,0,166.143.185.255
AT$APP PARAM 1282,1,172.90.255.255
```

It is also common for users to up the host port baud and modem port rate of the LMU when using dial-up networking. In this case, however, there is really no point. Both the iDEN modem port speed (38 400 bps) and the default host port speeds (115 200 bps) well exceed the maximum throughput of the wireless network (~10 000bps).

The last thing we want to deal with is preventing any automatic resets of the LMU's wireless modem. If a reset of the modem occurs, the Dial-Up networking session with a host device (laptop or PDA) also resets thus making for a poor user experience.

Looking back at the Working with Comm section we find the following points for automatic resets:

- Send Fail Restart
- Log Activity Restart
- Connection Monitoring
- Querying for Network Status

On the iDEN side, the Query for Network Status doesn't exist and can thus be ignored, however, the other three should be turned off.

To turn off the Send Fail Restart you would use:

```
ATS149=0
```

To turn off the Log Activity Restart you would use:

```
ATS157=0
```

And lastly to turn off the Connection Monitor, you would use two commands:

```
ATS152=0
AT$APP PARAM 1024,34,8,8
```

[23] With the exception of the PULS address, these IPs were chosen at random.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

From an LMU setup stand-point, this is all we should need to do to enable the Local Application and Remote Application to work. To complete the solution the PEG Script in the PEG Programming Guide should also be applied.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

14.2 PEG Programming – Long Haul Trucks

14.2.1 Project Overview

For our second example we will look at Hagensville Trucking. Hagensville Trucking is the leading provider of hazardous material transportation and has extensive operations around Hagensville, its surrounding state (known as Hagen). They also operate in cities throughout the three neighboring states (Adorno, Hegel and Neihart).

Hagensville Trucking wants to add GPS capabilities to both their trucks and their hazardous material trailers. The GPS project was initiated based on the following concerns:

- They have had a recent PR nightmare by losing several trailers full of radioactive waste from the Hagen nuclear power plant. While each of the trailers was recovered without loss of the material, the fact it took up to 14 days has made headlines.
- They are starting to develop logistical and legal problems accurately reporting their mileage in each state. This is for gas tax claims and refunds.
- Several vehicles have missed scheduled maintenance windows and have broken down mid-route.
- Some drivers are taking on side jobs and leaving the toxic payloads on non-sanctioned sites. As a result the vehicles are in use for longer hours than expected with drivers routinely breaking speed limits.
- Drivers are not following safety procedures within the various delivery areas and processing sites. In most cases this means leaving the vehicle running while unloading their cargo.

14.2.2 Project Proposal

For this project we are going to split things into two parts. The first part focuses on the trailers using the LMU-1000™ and the second part will be looking at the trucks using the LMU-4100™. By selecting the LMU-1000™, we automatically make the technology choice of GSM. We are in luck since the GSM operator does have coverage in all three states.

14.2.2.1 Project Proposal – Trailer Tracking – LMU Requirements

For the LMU-1000™ piece, we need to know a couple of things about the trailers. First off, we need to know what power (if any) the trailers offer. Again, we are in luck and each trailer is equipped with a battery and some measure of solar charging circuitry. We will use this as our primary power source. We will need to be aggressive on power control to maximize the battery's life. We are also somewhat lucky in that the trailer receives power from the truck's power supply when it is in use. The trailer's battery is a 9Volt supply, where the truck's is 12V. We might be able to use this difference to detect the presence of a vehicle.

Each trailer has a load and unload hatch. The trailer itself is equipped with a mechanism to make sure only one of these is open at a time but we will, however tap into both for our own detection purposes. We also need to make sure that nothing is transmitting during a load or unload operation. For the LMU-1000™ this means we need to put the device to sleep. For

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

the LMU-4100™ we simply can turn the modem off. We also need to make sure these signals are routed from the trailer to the truck so they can be detected by the LMU-4100™.

14.2.2.2 Project Proposal – Local Application

This solution does not have a local application.

14.2.2.3 Project Proposal – Remote Application

The remote application here will be a stripped down version of what we used in the delivery fleet solution. It will need to do the following:

- Receive LMU Event messages from the LMUs. This includes differentiating between event codes.
- Acknowledge messages sent from the LMUs

The main workload for the remote application will be in the reporting engine. The engine will need to be modified to create the reports necessary for this client. This could include reports such as State Mileage for Gas Tax credit, empty trailer availability, truck availability, etc.. It should also fire alarms when vehicles disregard safety procedures.

14.2.3 LMU Setup – Planning

The setup of the LMU-1000™ and LMU-4100™ boils down to two items, setting up the Inbound and setting up the four inputs we will be using:

- Ignition On/Off detection
- Trailer connect and disconnect
- Trailer loading
- Trailer unloading

To support the inputs, we have created the following Input mappings for our solution.

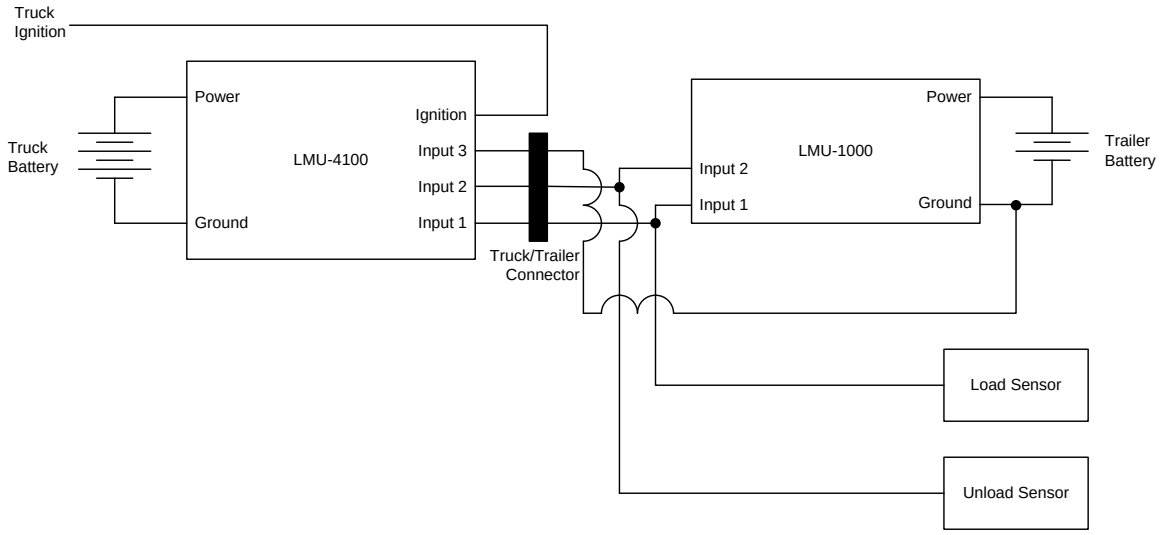
Input	LMU-1000™ Use	LMU-4100™ Use
Ignition	N/A	Truck Ignition
Input 1	Load Hatch Open/Close	Load Hatch Open/Close
Input 2	Unload Hatch Open/Close	Unload Hatch Open/Close
Input 3	N/A	Trailer Detect
Input 4	N/A	
Output 0	N/A	Load/Unload When On

On the Hatch events, a High signal indicates the hatch is open, and a Low signal indicates it is closed. For the trailer detections, a High signal indicates that the trailer is not present, where a Low signal indicates that it is.

Planning out the connections, our circuit would look similar to the following:

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential



14.2.4 LMU Setup – Development – LMU 4100™

14.2.4.1 Setting up the Inbound Address

We are once again going to assume we have an LM Direct server at our hosting center using the IP address of 172.90.80.241. We have gone one step further and set up a URL that will point this customer's LMUs to this IP address. The URL is "HagenTrucking.HSIInc.com".

Our first two setup commands are therefore:

```
AT$APP INBOUND 172.90.80.241:20500
AT$APP PARAM 2319,0,"HagenTrucking.HSIInc.com"
```

14.2.4.2 Setting up the Inputs

When working with Inputs, there are really two items you need to consider, the function (Input or Output) and the Bias (High or Low). Based on our mapping above, we will be using Inputs 0, 1, 2 and 3. Inputs 0 and 3 are always inputs, so we do not need to worry about their function. Inputs 1 and 2, however can be either Inputs or Outputs. We want to make sure they're Inputs which gives us the following command:

```
ATS159=0 (i.e. bits 0 and 1 are cleared)
```

For the Bias, we can again ignore Input 0 since it is always biased Low. The trailer detect circuit is active Low, that is, Input 3 will be connected to ground when the truck connects to the trailer and be open circuited when the trailer disconnects This means we will want the Input biased High.

```
AT$APP PARAM 1024,38,8,8 (i.e. set bit 3)
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Inputs 1 and 2 are connected to the Load and Unload sensors, which switch between High and Low signals so while the trailer is connected, the bias isn't terribly important (i.e. we do not need to deal with the open circuit case). We do, however, want to make sure the Inputs register as closed works when the truck is disconnected. This will ensure we do not get any false safety violations alerts. For this reason we will want the Inputs to be normally low. That is, the hatches are closed. This would give:

```
AT$APP PARAM 1024,38,4,0 (clear bit 2 of S158)
AT$APP PARAM 1024,38,2,0 (clear bit 1 of S158)
```

Once the Input bias and functions have been changed it is a good idea to reset the LMU to make sure the changes take effect.

14.2.5 LMU Setup Development – LMU-1000™

14.2.5.1 Setting up the Inbound Address

The Inbound set up of the LMU-1000™ is slightly different from the LMU-4100™. It is better to just use the Inbound URL and let the DNS look-up manage the Inbound IP address. It also makes set up a little easier since our configuration commands are sent via SMS[24]. Our first SMS setup command is therefore:

```
!R1 2319,0,"HagenTrucking.HSIInc.com"
```

14.2.5.2 Setting up the Inputs

The Input setup of the LMU-1000™ is similar to the LMU-4100™. That is, for each Input we need to select a function (Input or Output) and determine its Bias. On an LMU-1000™, only Input 2 can be set up as an Input or Output. For this example we want it as an Input. This gives:

```
!R1 1024,39,2,0     (i.e. clear bit 1)
```

For the Bias we will want Inputs 1 and 2 to match the Bias of Inputs 1 and 2 on the LMU-4100™. This is to prevent any false hatch readings on the LMU-4100™[25]. This means clearing bits 1 and 2 of S-Register 158. Since we're using SMS to program, we will want to use a single message:

```
!R1 1024,38,6,0     (i.e. clear bits 1 & 2)
```

With the Inbound and Inputs configured, this should complete the setup of both types of LMU.

[24] It would make far more sense, and likely cost less, to use PULS

[25] If we set the bias high, the LMU-4100 would potentially detect a hatch open event every time a trailer was connected, regardless of actual hatch state.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

14.3 LMU Programming – Taxi System

14.3.1 Project Overview

The final project we are going to look at is for the Hagensville Cab Company. The Hagensville Cab Company is a small organization with approximately 20 vehicles and, as of late, has been losing business to larger fleets. The owners are hoping that by adding a GPS device they can improve their efficiency and add a couple of services their competitors do not offer. They are looking for the following:

- Real-Time updates from each vehicle
- Distance travelled, drive times and idle times for maintenance purposes
- Messaging between the cab and the back end system (i.e. dispatch)
- Real-Time Credit Card processing (they've had a few problems with fraudulent credit cards)
- Notification of when a cab becomes available

For their backend piece they are looking for two applications. This first application is to be used by their dispatcher to route cabs to the nearest customer as well as run management reports. The second application is to be part of their external website and is designed to allowing visitors to reserve the nearest cab and view arrival estimates.

14.3.2 Project Proposal

14.3.2.1 LMU Requirements

As with the previous two projects, we will start with the choice of wireless technology. In this case, the decision will be made based on coverage. All three operators do have coverage within Hagensville and its airport, however only the CDMA operator has sufficient coverage in the surrounding suburbs.

On the peripheral and I/O front the LMU will need to be able to handle the following:

- Ignition Sense
- A connection to an MDT for dispatch messaging
- A connection to a card-reader for credit card processing

While we do not need the expanded I/O, the second serial device does mean we need the AUX port that is only available on the ioPOD.

14.3.2.2 Local Application Requirements

The local application will be in two parts, an MDT to handle messaging between the driver and the dispatcher and a credit card reader to handle payment processing. We are planning to take advantage of the LMU's User Messaging feature to handle both devices. As mentioned, this means that we will need the ioPOD with Aux Port.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

For the MDT we will need the following messages:

- Cab Available (Driver –> Dispatch)
- Request Pickup, includes address (Dispatch -> Driver)
- Cab in use (Driver -> Dispatch)
- Cancel Pickup (Dispatch -> Driver)
- At pickup (Driver -> Dispatch)

For the driver messages, each will be assigned to a particular button on the MDT. The incoming messages will be shown on the four line display.

On the credit card processing side we would like the card reader to encrypt the credit card data before sending it to through LMU. The LMU, in turn sends the message to the back end (again using an unacknowledged service). The back end will decrypt the data and forward it to the credit card processing agent. Once an authorization has been received, notification is sent back to the LMU and credit card reader to allow the transaction and print a receipt.

14.3.2.3 Remote Application Requirements

The remote application will need to support the following high level features to meet the customer's needs:

- Send and Receive Messages to/from the MDT.
- Display all MDT messages to the Dispatch application.
- Display all vehicle locations in the dispatch application including availability status
- Display only available cabs in the website application
- Display ETA to pickup data for 'reserved' cabs in website application
- Receive and decrypt credit card data
- Process credit card data with an appropriate clearing house
- Send a response to the MDT based on credit card authorization
- Return authorization notification to the credit card reader connected to the LMU

14.3.3 LMU Programming – Planning

In the setup of the LMU, we really have four main areas of concern.

- Set up of the Host Port to work with the MDT
- Set up of the Aux Port to work with the credit card reader
- Set up of the LMU to report to the appropriate server
- Security between the LMU and the Data Center

For our Mobile Data Terminal, we have settled on the somewhat standard Net-955 from Micronet. We have built a messaging application into this device to be able to handle the requirements laid out in the Local Application section above.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

As far as the LMU's setup goes, we need to know the follow about the application:

- Messaging occurs at 19200 BAUD, 8 Data Bits, No Parity and 1 Stop Bits.
- Every Message is terminated by a Line Feed character (0x0A)

For our credit card reader we will be using some measure of Point of Sale Terminal[26]. The terminal itself would need a serial connection and a printer to meet our needs. For this example we will assume that the serial port settings are the same as the Net955.

For the Inbound side we will be using another server in our data center, though we will not be accessing it from its public IP address. We have purchased a frame-relay link from the CDMA carrier in order to have a secure path between the LMU and data center. All LMUs will be assigned a 10.90.81.x address and our server will appear as 10.90.80.242.

14.3.4 LMU Setup – Development

14.3.4.1 Setting up the Inbound Address

The frame relay link we have between the CDMA carrier and our data center has defined what Inbound IP Address we should use, namely 10.90.80.242. We have not bothered to set up a URL as we are in a closed network and thus have no need for DNS services from the carrier.

Our first two setup commands therefore are:

```
AT$APP INBOUND 10.90.80.242:20500
AT$APP PARAM 2319,0,""
```

14.3.4.2 Configuring the Host Port

We will be using the Host Port in MDT mode to manage the Net955 connection for the dispatch application. This part of our setup will therefore focus on S-Registers 130-138.

Our starting point will be in selecting the type of User Message to work with, either the standard User Message or the User Message with Accumulators. In looking at the PEG Script we find that the accumulators are only meaningful after certain events (e.g. Ignition off, moving, etc…) so there's no point in reporting them as part of the User Message. This means we should clear bit 1 of S-Register 140.

```
AT$APP PARAM 1024,20,2,0
```

Keep in mind that this setting affects the User Messages created by both the Host Port and Aux Port.

At this point we should also choose the disposition of the message, that is, should it be logged. In this case the answer is yes. Even if the vehicle is out of coverage we will want the

[26] HyperCom or VeriFone would be likely sources.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

various messages stored so we can create activity reports on the back end later. For the disposition we will therefore use Send/Log.

```
ATS137=1
```

Once the type of message is selected, our next step is to determine the User Messaging mode, that is, do we need to support Long Message mode. Given the messages we're sending fit well within the 802 byte limit on User Messages, we can keep things in standard mode, giving:

```
ATS130=1
```

Next we need to setup the serial connection. The Net955 generally uses 9600 BAUD, 8 Data Bits, No Parity and 1 Stop Bit. The LMU's Host Port should be configured to match:

```
ATS131=5
ATS132=3
```

The messages from the Net955 will be in plain text and thus we can make use of a Termination Character. The developer of the Net955's application had made this Line Feed. (Actually they made it Carriage Return and Line Feed but since the LMU can only deal with one character, we must pick the last that appears.)

```
ATS133=4
ATS134=10
```

Since we are using a termination character, we can turn the other message creation limits off (i.e. time and size)

```
ATS135=0
ATS138=0
```

We should also turn off the Message Count Filter:

```
ATS141=0
```

We need to select a User Message ID value. Remember that this setting has two purposes, first any message created on the Host Port will be tagged with this type, and second it is used as a filter. That means any message sent to the LMU intended for the Host Port must have the same User Message ID value. For our Host Port we are going to use a value of 1.

```
ATS136=1
```

Our last step is to actually ensure that the Host Port is in MDT mode. This is done by running a jumper wire from pin 2 to pin 3 on the ioPOD. Keep in mind that this should only be done after all the host port setup commands have been completed as AT Commands are not processed while the LMU is in MDT mode.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

14.3.4.3 Configuring the Aux Port

The setup of our Aux Port takes a similar series of steps as the Host Port since the Point of Sale Terminal is a serial device. The only main different is that we will be focusing on S-Registers 160 through 169

Our starting point is again the mode of the Aux Port. The Aux Port doesn't support long message mode, but it does support NMEA output. The Point of Sale Terminal only handles data based on credit card processing so we will want to make sure NMEA mode is turned off:

```
ATS160=0
```

The User Message ID has already been chosen by the Host Port setup, so we can move onto the message disposition. Given this is a credit card transaction; we will want to send the message as soon as possible but not lose it. This means we will again use a Send/Log option.

```
ATS167=2
```

The serial settings for the Point of Sale Terminal are the same as the Net955, that is, 9600 BAUD, 8 Data Bits, No Parity and 1 Stop Bit.

```
ATS161=5
ATS162=3
```

The Point of Sale Terminal's message is always encrypted and thus we cannot rely on a single Termination Character, so we should turn that feature off.

.

```
ATS163=0
ATS164=0
```

The Point of Sale Terminal's message does however, have a standard length, namely 120 bytes. We will use this as the Message Termination Length.

```
ATS165=30
```

We can turn off the Message Termination Time limit and the Message Count Filter.:

```
ATS168=0
ATS169=0
```

Lastly we need to select a User Message ID for the credit card messages. It's generally a good idea to make this a different value than what's used for the Host Port messages, though it's not strictly necessary. We are going to use a value of 2.

```
ATS166=2
```


Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

With the two serial ports set up and the Inbound Address programmed, this should complete the LMU configuration with the exception of the PEG Script. Again, that set up for this example is described in the PEG Programming Guide.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

APPENDIX A – PARAMETER DEFINITIONS

The follow table describes all parameters supported across the various LMU platforms. The second table of this appendix details which devices support which parameters.

Name	ID Value	Index Range	Data Size (bytes)	Data Description
Last Parameter	0	0..0	0	No Data – Denotes the last parameter in a parameter read/write request
General Config Parameters				
Access Enables	1280	0..0	2	8-bit mask (which bits to program) 8-bit value bitmapped as follows: bit 7: spare bit 6: Fixed Inbound Address bit 5: Include Port in Dynamic Redirection bit 4: Enable NEI Cycling (Not Used) bit 3: Random Inbound bit 2: Static Inbound bit 1: Enable OTA Download (Not Used) bit 0: Enable Ping Response
Accumulator Value	2560	0..15	4	32-bit unsigned int
GPS Lost Timeout	1027	0..0	4	32-bit unsigned int Amount of time the LMU will wait before declaring the GPS Fix Status to be Lost. (1 sec LSB)
GPS Last Known Timeout	1028	0..0	4	32-bit unsigned int Amount of time the LMU will wait before declaring the GPS Fix Status to be Last-Known. (1 sec LSB)
Input Wake-Up Monitor	1029	0..0	2	8-bit mask (which bits to program) 8-bit value bitmapped as follows: bit 7: Wake up on RxD transition bit 6: Wake up on RTS transition bit 5: Wake up on DTR transition bit 4: Wake up on Input 4 transition bit 3: Wake up on Input 3 transition bit 2: Wake up on Input 2 transition bit 1: Wake up on Input 1 transition bit 0: Wake Up on Ignition transition
LMU Application Version	1792	0..2	1	1 byte (ASCII char) Index 0: Major Version Index 1: Minor Version Index 2: Revision
Local Time-zone	1030	0..0	2	8-bit mask (which bits to program) 8-bit value bitmapped as follows: bit 7: spare bit 6: spare bit 5: Enable Daylight Savings bit 4- bit 0: Time-zone offset from GMT (special 5-bit signed int)

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Name	ID Value	Index Range	Data Size (bytes)	Data Description
Maintenance Message Configuration	2312	0..0	2	16-bit unsigned int Bit 7 – Bit 4 = Message Format 0 = Automatic based on Inbound 1 = LM Direct ID report 2 = LM eXchange ID report Bit 3 – Bit 0 = Update Times 0 = No Maintenance Updates 1 = Initial Comm Acquired OR Expired Maintenance Interval 2 = Every Comm Acquired OR Expired Maintenance Interval
MDT Enables	1026	0..0	2	8-bit mask (which bits to program) 8-bit value bitmapped as follows: bit 7: spare bit 6: spare bit 5: spare bit 4: spare bit 3: Local Free Text Enable bit 2 – bit 0: Inbound Send Disposition (special 3-bit unsigned int) (0=undefined, 1=send, 2=sndlog, 3=log, 4=priority)
Mobile ID : MIN (Phone Number)	2305	0..0	17	3 bytes (ASCII chars) + null byte Bytes must be ASCII digits
Mobile ID : User Defined	2304	0..0	17	3 bytes (ASCII chars) + null byte Bytes must be ASCII digits
Moving Speed Threshold	1035	0..0	2	16-bit unsigned int Moving Speed Threshold used by the LMU. LSB = 1cm/s
Null Message Interval	2313	0..0	2	16-bit unsigned int How often the LMU will send a null message to the Inbound Address. LSB = 1s
Service Enables	1025	0..0	2	8-bit mask (which bits to program) 8-bit value bitmapped as follows: bit 7: spare bit 6: spare bit 5: spare bit 4: spare bit 3: Enable TAIP Interface bit 2: Enable Inbound Messaging bit 1: Enable Event Reporting bit 0: Enable PEG
S-Register	1024	0..47	2	8-bit mask (which bits to program) 8-bit value, specific to index See other document for encoding rules Index indicates which S-Register (Index 0 = Register 120)
Report Delivery Parameters				
Inbound URL	2319	0..1	64	63 bytes (ASCII chars) + null byte The URL of the Inbound server.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Name	ID Value	Index Range	Data Size (bytes)	Data Description
Inbound IP Address List	768	0..3	4	32-bit unsigned int IP Address the LMU will deliver reports to
Inbound Port List	769	0..3	2	16-bit unsigned int UDP Port the LMU will deliver reports to.
Inbound Retry Schedule	771	0..5	1	8-bit unsigned int Length of time the LMU will wait between send attempts for Acknowledged Message type. (LSB = 1 s) The Index represents the attempt count. (i.e. Index 0 – interval after first attempt)
Local UDP Port	774	0..0	2	The UDP Port the LMU will use to listen for incoming UDP/IP messages. Typically set to 20510.
Log Retry Timer (Ignition On)	1031	0..0	4	32-bit unsigned int Delay between log send attempts when Ignition is On., <LSB=1-second, 0=off>
Log Retry Attempts (Ignition On)	1032	0..0	1	8-bit unsigned int Number of times the LMU will attempt to deliver its log.
Log Retry Timer (Ignition Off)	1033	0..0	4	32-bit unsigned int Delay between log send attempts when Ignition is Off., <LSB=1-second, 0=off>
Log Retry Attempts (Ignition Off)	1034	0..0	1	8-bit unsigned int Number of times the LMU will attempt to deliver its log.
Maintenance URL	2320	0..0	64	63 bytes (ASCII chars) + null byte URL of the Maintenance server.
Maintenance Message Inbound IP Address	2310	0..0	4	32-bit unsigned int IP Address the LMU will deliver maintenance messages to
Maintenance Message Inbound Port	2311	0..0	2	16-bit unsigned int UDP Port the LMU will deliver maintenance messages to.
Maintenance Message Interval	2322	0..0	4	32-bit unsigned int How often a maintenance message is sent to the Maintenance Server. (LSB = 1 s)
SMS Inbound Address	2321	0..0	16	0 bytes (ASCII chars) + null byte SMS destination address (i.e. a phone number) for Priority Messages
Unit Access Parameters				
Remote Host IP Address List	1282	0..3	4	32-bt unsigned int IP Addresses a host device (eg Laptop) is allowed to talk to when using the LMU as a modem
Access IP Address List	1281	0..3	4	32-bit unsigned int IP Addresses the LMU will respond to
Primary Port Password	1283	0..0	4	32-bit unsigned int 'Password' used to access the LMU. This is the password remote clients would use in the authentication field of the Options Header.
Report Contents Parameters				

Copyright ©CalAmp DataCom Inc 2009

Name	ID Value	Index Range	Data Size (bytes)	Data Description
Accumulator Reporting – Accumulator Count by Event Code	770	0..7	2	8-bit unsigned int: Number of accumulators to report for the specified Event Code 8-bit unsigned int: Event Code
Inbound Event Report Contents	772	0..0	4	16-bit mask (which bits to program) 16-bit value bitmapped as follows: bit 15: spare bit 14: spare bit 13 – 9: Number of accumulators to report (special 5-bit unsigned int): (0 = 0, 1=4, 2=1, 3=5, 4=2, 5=6, 6=7, 7=(Not allowed), 8=3, 9=16, 10=17, 11=18, 12=19, 13=20, 14=21, 15=22, 16=23) bit 8: Zone States bit 7: extended options (i.e. enable bits 8-15) bit 6: reserved bit 5: I/O Status bit 4: Carrier Info bit 3: Comm Status (RSSI, Channel, Availability) bit 2: Pseudo-ranges to Sats bit 1: obsolete bit 0: altitude
Logged Event Report Contents	773	0..0	4	Same as Inbound Event Report Contents
Comm Config Parameters				
Packet Dial String	2316	0..1	16	0 bytes (ASCII chars) + null byte Dial strings used to setup a data connection to the wireless network GPRS = *99***1# CDMA = #777 iDen = 0
Packet Dial String – Current Index	2317	0..0	1	8-bit unsigned int Index of the current Packet Dial String being used by the LMU.
PRL Dial String	2318	0..0	16	0 bytes (ASCII chars) + null byte Dial strings used to download any PRL updates from the wireless network
Modem Password (CDMA SPC)	1284	0..0	4	32-bit unsigned int SPC for a CDMA modem. The SPC is typically a 6 digit decimal value.
Event Record	512	0..149	8	8-bit unsigned int (Trigger Code) 8-bit unsigned int (Trigger Modifier) 8-bit unsigned int (Condition Code) 8-bit unsigned int (Condition Modifier) 8-bit unsigned int (Action Code) 8-bit unsigned int (Action Modifier) 8-bit unsigned int (Condition Code – 2) 8-bit unsigned int (Condition Modifier – 2)
GPRS Context String	2306	0..1	64	63 bytes (ASCII chars) + null byte LMU-1000: 30 bytes (ASCII Chars) + null byte GPRS Service and Context settings.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Name	ID Value	Index Range	Data Size (bytes)	Data Description
GPRS Context – Current Index	2307	0..0	1	8-bit unsigned int Index of the current GPRS Context being used by the LMU
Modem SIM PIN	1285	0..0	4	32-bit unsigned int PIN for a GSM modem. The PIN is typically a 4 digit decimal value.
Network Discriminant – Condition	1537	0..3	1	8-bit unsigned int Network Discriminant Condition: 0=ignore 1=required 2=preferred 3=exclude
Network Discriminant – Value	1538	0..3	2	16-bit unsigned int Network Discriminant Number
Network Discriminant – Type	1536	0..3	1	8-bit unsigned int Network Discriminant Type: 0=not used 1=SPI 2=WASI 3=SPNI
Network Side Preference (CDPD Only)	1539	0..0	1	8-bit unsigned int Side Preference settings of a CDPD Modem: 0=not defined 1=Side-A only 2=Side-B only 3=Side-A Preferred 4=Side-B Preferred
Network Sleep Settings (CDPD Only)	1540	0..0	1	8-bit unsigned int Network sleep settings of a Novatel Wireless CDPD modem: 0=disabled 1=Long Sleep Mode 2=Short Sleep Mode
Network Username	2314	0..1	64	63 bytes (ASCII chars) + null byte User name assigned by the wireless service provider
Network Password	2315	0..1	16	15 bytes (ASCII chars) + null byte Password assigned by the wireless service provider
Caller ID String	2323	0..0	16	The phone number to match incoming calls against.
TAIP Parameters				
TAIP Enables	2048	0..0	2	8-bit mask (which bits to program) 8-bit value bitmapped as follows: bit 7 – enable Input Status Reporting bit 6 - enable Event code reporting bit 5 – enable directed reporting bit 4 – Append <CR><LF> to end of messages bit 3 – Frequency Reporting bit 2 – Echo 'Set' Commands bit 1 – Append ID to Messages

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Name	ID Value	Index Range	Data Size (bytes)	Data Description
				bit 0 – Append Checksum to messages
LMU TAIP Listening Port	2051	0..0	2	16-bit unsigned int UDP Port Number the LMU will listen on for incoming TAIP Messages
TAIP Message Selection	2049	0..0	2	8-bit mask (which bits to program) 8-bit value bitmapped as follows: bit 7: Enable Accumulator Reporting bit 6: Send received SMS messages to TAIP IP and Port bit 5: spare bit 4: spare bit 3: spare bit 2: Send IO messages bit 1: Send LN messages bit 0: Send PV messages
TAIP Remote IP Address	2052	0..0	4	32-bit unsigned int IP Address the LMU will send TAIP Messages to.
TAIP Remote Port	2053	0..0	2	16-bit unsigned int UDP Port number the LMU will send TAIP messages to.
TAIP Vehicle ID	2050	0..3	1	1 byte (ASCII char) Only digits allowed Index 0 – Most Significant Digit Index 3 – Least Significant Digit
PEG Parameters				
Acceleration Sample Count	278	0..3	1	8-bit unsigned int
Acceleration Threshold	277	0..3	4	32-bit signed int (2's Compliment)
Accumulator Threshold	266	0..15	4	32-bit unsigned int
A/D Threshold	276	0..3	2	16-bit unsigned int
Day of Week	269	0..3	2	8-bit mask (which bits to program) 8-bit value bitmapped as follows: bit 7: spare bit 6: Saturday bit 5: Friday bit 4: Thursday bit 3: Wednesday bit 2: Tuesday bit 1: Monday bit 0: Sunday
Environment Mask	273	0..7	8	32-bit mask (which bits to program) 32-bit value bitmapped as follows: bit 31: Enable In Motion bit 30: Enable Log Active bit 29: Enable Comm Acquired bit 28: Enable GPS Acquired bit 27: Enable Input 3 bit 26: Enable Input 2 bit 25: Enable Input 1 bit 24: Enable Input 0 bit 23: Enable Day-of-Week 3 bit 22: Enable Day-of-Week 2

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Name	ID Value	Index Range	Data Size (bytes)	Data Description
				bit 21: Enable Day-of-Week 1 bit 20: Enable Day-of-Week 0 bit 19: Enable Speed 3 bit 18: Enable Speed 2 bit 17: Enable Speed 1 bit 16: Enable Speed 0 bit 15: spare bit 14: spare bit 13: Enable Zone 5 bit 12: Enable Zone 4 bit 11: Enable Zone 3 bit 10: Enable Zone 2 bit 9: Enable Zone 1 bit 8: Enable Zone 0 bit 7: Enable PEG Flag 7 bit 6: Enable PEG Flag 6 bit 5: Enable PEG Flag 5 bit 4: Enable PEG Flag 4 bit 3: Enable PEG Flag 3 bit 2: Enable PEG Flag 2 bit 1: Enable PEG Flag 1 bit 0: Enable PEG Flag 0
Input Trigger Controls – Debounce Timer	270	0..5	1	8-bit unsigned int Input's debounce interval, LSB= 1s
Input Trigger Controls – Delay Input High Timer	271	0..5	1	8-bit unsigned int Input's delay high trigger interval, LSB= 1s
Input Trigger Controls – Delay Input Low Timer	272	0..5	1	8-bit unsigned int Input's delay high trigger interval, LSB= 1s
Input Equate	256	0..3	1	8-bit unsigned int Input Compare Trigger Modifier list element. Bitmapped as follows: bit 7: spare bit 6: spare bit 5: Input 5 bit 4: Input 4 bit 3: Input 3 bit 2: Input 2 bit 1: Input 1 bit 0: Input 0
PEG Enables	1037	0..0	4	32-bit mask (which bits to program) 32-bit value bitmapped as follows: bit 31: PEG Enable 31 . . . bit 1: PEG Enable 1 bit 0: PEG Enable 0
Speed Trigger Controls – Speed Threshold	257	0..3	2	16-bit unsigned int Speed threshold (LSB = 1cm/s)
Speed Trigger Controls – Debounce Timer	258	0..3	1	8-bit unsigned int Speed Threshold's debounce interval, LSB= 1s

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Name	ID Value	Index Range	Data Size (bytes)	Data Description
Speed Trigger Controls – Delay Speed Above Timer	260	0..3	1	8-bit unsigned int Speed Threshold's delay above trigger interval, LSB= 1s
Speed Trigger Controls – Delay Speed Below Timer	259	0..3	1	8-bit unsigned int Speed Threshold's delay below trigger interval, LSB= 1s
Text String - Long	2176	0..7	64	63 bytes (ASCII chars) + null byte Text message for use with a Generic Serial device or SMS message
Text String – Short	2177	0..15	16	0 bytes (ASCII chars) + null byte Text message for use with a Generic Serial device or SMS message
Time-Distance Profile – Time Elapsed	262	0..3	4	32-bit unsigned int Time portion of the Time-Distance profile, (LSB=1-second)
Time-Distance Profile – Distance Traveled	263	0..3	4	32-bit unsigned int Distance portion of the Time-Distance profile, (LSB=1-meter)
Time-Distance Profile – Heading Change	264	0..3	1	8-bit unsigned int Heading Change portion of the Time-Distance profile, (LSB=1-degree)
Time-Distance Profile – Minimum Time Interval	275	0..3	4	32-bit unsigned int Minimum Time portion of the Time-Distance profile, (LSB=1-second)
Timer Timeout	265	0..15	4	32-bit unsigned it Count-down timer value (LSB = 1s)
Time of Day Setting – Time	267	0..3	4	32-bit unsigned int Time of day as sections from 00:00 (LSB = 1s)
Time of Day Setting – Repeat Interval	268	0..3	2	16-bit unsigned int Repeat interval for a Time-Of Day Trigger. Maximum value is 12 hours, LSB = 1 sec
User Flag	1036	0..0	2	8-bit mask (which bits to program) 8-bit value bitmapped as follows: bit 7: spare bit 6: spare bit 5: spare bit 4: spare bit 3: User Flag 3 bit 2: User Flag 2 bit 1: User Flag 1 bit 0: User Flag 0
Zone Definition	261	0..31	18	32-bit signed int: Latitude 32-bit signed int: Longitude 32-bit unsigned int: East Distance (LSB = 1m) 32-bit unsigned int: North Distance (LSB = 1m) 1 byte: Zone Geomtery 8-bit unsigned int: Hysterisis (LSB = 1m)
Bluetooth Parameters				
Bluetooth Name	2080	0..0	16	0 bytes (ASCII chars) + null byte Defines the name the LMUs Bluetooth adapter

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Name	ID Value	Index Range	Data Size (bytes)	Data Description
				will attempt to connect to.
Bluetooth PIN	2081	0..0	4	32 bit unsigned int. The PIN value remote devices must use when connecting to the LMU's Bluetooth adapter.

Copyright ©CalAmp DataCom Inc 2009

For the purposes of Parameters, there are effectively 4 different platforms, the LMU-4100, the LMU-2500, the LMU-1000/1500 and the 8-Bit products (MTU-100, LMU-900, LMU-1100 and LMU-1200).

The follow table describes which Parameters are available to each device type. The entry in the device column can take one of three values:

- X – Indicates that all released firmware versions for the device support the parameter and the referenced index range.
- 0.0.a – A firmware version indicates that the parameter and index range are only support on that firmware version or higher.
- 0..0 – This indicates that the device supports a different index range for the given parameter. This range applies to all released versions of firmware for the device.

Name	ID Value	Index Range	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
Last Parameter	0	0..0	X	X	X	X
General Config Parameters						
Access Enables	1280	0..0	X	X	X	X
Accumulator Value	2560	0..15	X	X	X	X
GPS Lost Timeout	1027	0..0	X	X	X	X
GPS Last Known Timeout	1028	0..0	X	X	X	X
Input Wake-Up Monitor	1029	0..0	X	X	X	X
LMU Application Version	1792	0..2		X	X	X
Local Time-zone	1030	0..0	X	X	X	X
Maintenance Message Configuration	2312	0..0	X	X	X	X
MDT Enables	1026	0..0				X
Mobile ID : MIN (Phone Number)	2305	0..0	X	X	X	X
Mobile ID : User Defined	2304	0..0	X	X	X	X
Moving Speed Threshold	1035	0..0	X	X	X	X
Null Message Interval	2313	0..0	X	X	X	X
Service Enables	1025	0..0	X	X	X	X
S-Register	1024	0..63	See Appendix B			
Report Delivery Parameters						
Inbound URL	2319	0..1	X	X	X	X
Inbound IP Address List	768	0..3	X			X
Inbound Port List	769	0..3	0..1	X	X	X
Inbound Retry Schedule	771	0..5	X	X	X	X
Local UDP Port	774	0..0	1.3c		1.1d	8.4c

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Name	ID Value	Index Range	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
Log Retry Timer (Ignition On)	1031	0..0	X	X	X	X
Log Retry Attempts (Ignition On)	1032	0..0	X	X	X	X
Log Retry Timer (Ignition Off)	1033	0..0	X	X	X	X
Log Retry Attempts (Ignition Off)	1034	0..0	X	X	X	X
Maintenance URL	2320	0..0	X	X	X	X
Maintenance Message Inbound IP Address	2310	0..0				X
Maintenance Message Inbound Port	2311	0..0	X	X	X	X
Maintenance Message Interval	2322	0..0	X	X	X	X
SMS Inbound Address	2321	0..0	X	X	X	X
Unit Access Parameters						
Remote Host IP Address List	1282	0..3				X
Access IP Address List	1281	0..3				X
Primary Port Password	1283	0..0				X
Report Contents Parameters						
Accumulator Reporting – Accumulator Count by Event Code	770	0..7	X	X	X	X
Inbound Event Report Contents	772	0..0	X	X	X	X
Logged Event Report Contents	773	0..0	X	X	X	X
Comm Config Parameters						
Packet Dial String	2316	0..1	X	X	X	X
Packet Dial String – Current Index	2317	0..0	X	X	X	X
PRL Dial String	2318	0..0				X
Modem Password (CDMA SPC)	1284	0..0				X
Event Record	512	0..149			X	X
Event Record	512	0..99	X	1.4a		
Event Record	512	0..74		X		

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Name	ID Value	Index Range	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
GPRS Context String	2306	0..1	X	X[27]	X	X
GPRS Context – Current Index	2307	0..1	X	X	X	X
Modem SIM PIN	1285	0..0	X	X	X	X
Network Discriminant – Condition	1537	0..3				X
Network Discriminant – Value	1538	0..3				X
Network Discriminant – Type	1536	0..3				X
Network Side Preference (CDPD Only)	1539	0..3				X
Network Sleep Settings (CDPD Only)	1540	0..0				X
Network Username	2314	0..1	0..0	X	X	X
Network Password	2315	0..1	0..0	X	X	X
Caller ID String	2323	0..0	X	X	X	X
TAIP Parameters						
TAIP Enables	2048	0..0				X
LMU TAIP Listening Port	2051	0..0				X
TAIP Message Selection	2049	0..0				X
TAIP Remote IP Address	2052	0..0				X
TAIP Remote Port	2053	0..0				X
TAIP Vehicle ID	2050	0..3				X
PEG Parameters						
Acceleration Sample Count	278	0..3			1.1k	8.4a
Acceleration Threshold	277	0..3			1.1k	8.4a
Accumulator Threshold	266	0..15	X	X	X	X
A/D Threshold	276	0..3				X
Day of Week	269	0..3	X	X	X	X
Environment Mask	273	0..7				X
Input Trigger Controls – Debounce Timer	270	0..7	X	X	X	X
Input Trigger Controls – Delay Input High Timer	271	0..7	X	X	X	X

[27] The LMU-1000™ only supports 30 characters or less for APN/Context Strings. The other LMU's support up to 63 characters.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Name	ID Value	Index Range	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
Input Trigger Controls – Delay Input Low Timer	272	0..7	X	X	X	X
Input Equate	256	0..0		X	X	X
PEG Enables	1037	0..0	X	X	X	X
Speed Trigger Controls – Speed Threshold	257	0..3	0-0	X	X	X
Speed Trigger Controls – Debounce Timer	258	0..3	0-0	X	X	X
Speed Trigger Controls – Delay Speed Above Timer	260	0..3	0-0	X	X	X
Speed Trigger Controls – Delay Speed Below Timer	259	0..3	0-0	X	X	X
Text String - Long	2176	0..7				X
Text String – Short	2177	0..15	0	0	0	X
Time-Distance Profile – Time Elapsed	262	0..3	0-0	X	X	X
Time-Distance Profile – Distance Traveled	263	0..3	0-0	X	X	X
Time-Distance Profile – Heading Change	264	0..3	0-0	X	X	X
Time-Distance Profile – Minimum Time Interval	275	0..3	0-0	X	X	X
Timer Timeout	265	0..15	X	X	X	X
Time of Day Setting – Time	267	0..3	X	X	X	X
Time of Day Setting – Repeat Interval	268	0..3	X	X	X	X
User Flag	1036	0..0	X	X	X	X
Zone Definition	261	0..31	0-2	X	X	X
Bluetooth Parameters						
Bluetooth Name	2080	0..0				X
Bluetooth PIN	2081	0..0				X

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Appendix B – S-Register Settings

For the purposes of S-Registers, there are effectively 4 different platforms, the LMU-4100™, the LMU-2500™, the LMU-1000™ and the 8-Bit products (MTU-100™, LMU-900™, LMU-1100™ and LMU-1200™).
The follow table describes the functionality of the available S-Registers and which devices they apply to.

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
120	**Modem Select** *Description:* This S-Register controls which modem driver the LMU uses to connect to its wireless device when using Comm Index 0. Each driver decides what type of modem is being used for the LMU's data connectivity and if the LMU can poll the modem for network information (eg RSSI). The default Baud rate and Dial strings are also chosen by the driver. *Settings:* *LMU Drivers* 3 – **iDEN LMU** 19200, ATDT 0, PPP, Motorola iDEN Status – TC990569 5 – **GPRS LMU** 57600,ATD*99***1#, WaveCom 11 – **CDMA LMU** CDMA 1xRTT Modem – Kyocera M200 14 – **iDEN LMU** 19200, ATDT 0, PPP, CMUX Status – TC990599 15 – **GPRS LMU** 115200, ATD*99***1#, PPP, Siemens 17 - **CDMA LMU** CDMA 1xRTT Modem – WaveCom Q2438 18– **GPRS LMU** – ATD*99***1#, PPP, Siemens/Cinterion MC55	**X**		**X**	**X**

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
120 Cont…	*TetheredLocator Drivers* 128 – Generic 19200 BAUD, ATDT 0, No Status 129 – CDPD – Novatel Wireless NRM 6812 Series, 19200 BAUD ,AT\\ASLIP, MSCI Status 130 – CDPD – Novatel Wireless Expedite Series, 19200 BAUD ,AT\\APPP, MSCI Status 131 – iDEN - Motorola iDEN devices, 38400 BAUD, ATD0, RALP Status 132 – CDPD – Sierra Wireless MP200, 19200 BAUD, ATD0, No Status 133 – GSM/GPRS – WaveCom, 57600 BAUD, ATDT*99***#1, WMUX Status 134 – GSM/GPRS – Generic, 57600 BAUD, ATDT *99***#1, no Status 135 – CDPD – Ericsson R280d, 19200,BAUD, ATDT0, no Status 136 – TAIP Modem – 9600 BAUD, TAIP string sent directly to modem Serial port 137 – No Modem 139 – CDMA – Kyocera M200, 57600 BAUD, ATD#777, KMIP Status 140 – CDMA – Generic- 57600 BAUD, ATD#777, No Status 141 – TDMA – Sony Ericsson DM25, 9600 BAUD, (SMS Only), no Status 142 – iDEN – Motorola iDEN devices, 57600 BAUD, ATDT 0, CMUX Status 143 – GSM/GPRS – Siemens, 115200 BAUD, ATD*99***1#, PPP, Siemens 144 – Iridium Data Modem				X
121	**PEG Script ID** *Description:* This S-Register is reserved for use by the customer to Identify the Script Version seen in PULS. Users are advised not to change this setting locally. It should only be changed through PULS. *Settings:* Values can range from 0-255.	X	X	X	X
122	**Reserved**		X	X	X

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
123	**PPP Debug Level** *Description:* This S-Register sets the PPP debug levels used by the LMU. All debug messages are sent to the host port. This S-Register should only be used when directed by CalAmp personnel. *Settings:* Bit 0 – Bit 3 - These bits define the message priority level - 0= off - 1= display only highest priority messages - 2 = display high and medium priority messages - 3 = display all messages Bit 4 - Set –enables PPP debug string to be routed out GPS port for test purposes. - Cleared – PPP debug string is not sent.			**X**	**X**

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
124	**Debug Enables** *Description:* This S-Register sets the debug levels used by the LMU. All debug messages are sent to the host port. This S-Register should only be used when directed by CalAmp personnel. *Settings:* Bit 0 – Status Debug - Set = Enabled Debug Messaging - Cleared = Disabled Debug Messaging Bit 1 – MDT Debug - Set = Enabled Debug Messaging - Cleared = Disabled Debug Messaging Bit 2 – PCCMD Debug - Set = Enabled Debug Messaging - Cleared = Disabled Debug Messaging Bit 3 – Power Management Debug - Set = Enabled Debug Messaging - Cleared = Disabled Debug Messaging Bit 4 – Message(hex) dump Debug - Set = Enabled Debug Messaging - Cleared = Disabled Debug Messaging Bit 5 – PGMCYCLE Debug - Set = Enabled Debug Messaging - Cleared = Disabled Debug Messaging Bit 6 – Comm Status Debug - Set = Enabled Debug Messaging - Cleared = Disabled Debug Messaging Bit 7 – TDTEST Debug - Set = Enables the creation of an Event Report on every Time-Distance Update. The Event Code will increment with every Message - Cleared = Disables Time Distance Test Debug -				**X**

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
125	**Debug Enable** *Description:* This S-Register sets debug messaging levels used by the LMU. All debug messages are sent to the host port. This S-Register should only be used when directed by CalAmp personnel. *Settings:* Bit 0 – Debug On/Off - Set = Enables Debug Messaging - Cleared = Disables Debug Messaging Bit 1 – System Time - Set = the timestamp in the debug output is the system time - Cleared = the timestamp in the debug output is the time since start up Bit 2 – Debug On/Off - Set = Enables Multiple Debug Options for general purpose debug - Cleared = Standard debug output	X	X	X	X

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
126	**GPS Debug Enables** *Description:* This S-Register sets debug messaging levels used by the LMU in regards to GPS. All debug messages are sent to the host port. This S-Register should only be used when directed by CalAmp personnel. *Settings:* Bit 0 – Odometer (Odo) Message - Set = Enables the Odometer GPS Debug Messaging - Cleared = Disables the Odometer Debug Messaging Bit 1 – Position Update (Pos) Message - Set = Enables the Position Update GPS Debug Messaging - Cleared = Disables the Position Update Debug Messaging Bit 2 – GPS Debug - Set = Enables GPS Debug Messaging - Cleared = Disables GPS Debug Messaging Bit 3 – Route Serial Port Handler Debug out GPS Port - Set = Route Serial Port Handler Debug out GPS Port - Cleared = Does not route Serial Port Handler Debug out GPS Port Bit 4 – Real-Time Updates - Set = Causes an Unacknowledged Event Report to be sent with every real-time GPS Update - Cleared = Event Reports are not sent with every real-time GPS update				**X**

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
127	**Environment Restore** *Description:* The environment restore function allows the LMU to save certain items into non-volatile memory. These items will be restored on the next power up. *Settings:* Bit 0 – Restore Accumulator values - Set = The LMU will attempt to save and restore accumulator values - Cleared = The LMU will not store accumulator values through a power cycle Bit 1 – Restore PEG Flags - Set = The LMU will attempt to save and restore the states of the PEG flags - Cleared = The LMU will not store the states of the PEG flags through a power cycle Bit 2 – Restore Zone States - Set = The LMU will attempt to save and restore the state (inside/outside) of the PEG Zones (note this does not apply to Geo-Zones) - Cleared = The LMU will not store the PEG Zone states through a power cycle Bit 3 – GPS Last Known - Set = The LMU will attempt to save and restore the last position received by the GPS - Cleared = The LMU will not store the last-known GPS position through a power cycle Bit 6 – Store on Soft Reset - Set = The LMU will attempt to save the above values/states on a soft reset (AT$APP QUIT or Reboot Unit Request) - Cleared = The LMU will not store values on a soft reset Bit 7 – Store on Ignition Off - Set = The LMU will attempt to save the above values/states on an Ignition Off (i.e. input 0 Low) - Cleared = The LMU will not store values on an ignition off -	**X**	**X**	**X**	**X**

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
128	**NMEA Message Selection** *Description:* By setting any bit, or combination of bits in this S-register will force the LMU to send the specified NMEA messages out its host port. This allows the LMU to be used with laptop or PDA based tracking applications. *Settings:* Bit 0 – Enable/Disable GGA Message Bit 1 – Enable/Disable GLL Message Bit 2 – Enable/Disable GSA Message Bit 3 – Enable/Disable GSV Message Bit 4 – Enable/Disable RMC Message Bit 5 – Enable/Disable VTG Message Bit 6 – Enable/Disable ZDA Message Bit 7 – Enable/Disable UBlox PUBX, 00 message	1.1d		**X**	**X**
129	**Comm Disconnect Count** *Description:* This S-Register will control the number of Comm Disconnects the LMU must receive before switching GPRS Context Settings. *Settings:* 0-255 Comm Disconnects (0 = Off)	**X**	**X**	**X**	**X**
130	**Serial Port Mode Control** *Description:* This S-Register controls what mode the LMU's MDT Port is in. *Settings:* 1 = Generic Serial Device (GSD) 2 = Long Message Mode				**X**
131	**GSD Serial Port Baud Rate** *Description:* This S-Register will set the LMU's Host Port Baud rate while not in Standard mode *Settings:* 4 = 4800 5 = 9600 7 = 19200 9 = 38400 10 = 57600 12 = 115200				**X**

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
132	**Serial Port Word Definition** (Parity, Stop Bits, Word Size) *Description:* This S-Register will set the LMU's Host Port word definition while not in Standard mode *Settings:* Bit 0 – Bit 1 – Word Size 0 = 5 bits 1 = 6 bits 2 = 7 bits 3 = 8 bits Bit 2 – Stop Bits - Set = 2 Stop Bits - Cleared = 1 Stop Bit Bit 3 – Parity - Set = Parity Enabled - Cleared = No Parity Bit 4 – Parity Type - Set = Even Parity - Cleared = Odd Parity				**X**
133	**Serial Port Misc. Controls** *Description:* This S-Register will set the LMU's Host Port behavior while not in Standard mode *Settings:* Bit 2 - Termination Character - Set = Enables the use of the termination character for User Message creation - Cleared = Disables the use of the termination character for User Message creation				**X**
134	**GSD(User) Message Termination Character** *Description:* This S-Register will set the Termination Character to be used to end a user message *Settings:* Decimal value of the ASCII Character ranging from 0 -255.				**X**
135	**GSD(User) Message Termination Length** *Description:* This S-Register controls the maximum length of a User Message. *Settings:* The size of the user message ranging from 4 to 804 bytes. The S-register has an LSB of 4 bytes, so it will range from 0(4bytes) to 201 (804 bytes).				**X**

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
136	**GSD (User) Message ID** *Description:* This S-Register controls the User Message ID value assigned to any User Message sent by the LMU. It is also used by the LMU to match against incoming User Messages. The User Message ID of the incoming User Message must match the value contained in this S-Register in order for it to be passed to the Host Port. *Settings:* User Message ID values can range from 0 to 255.				**X**
137	**GSD(User) Message Disposition** *Description:* This S-Register controls the Disposition of the User Message. *Settings:* 1 = Send Message, Log if Send Fails 2 = Send Message, Log if Send Fails 3 = Log Message 4 = Priority Message 5 = Unacknowledged Message 7 = Route Incoming (Client to LMU) SMS messages to the host serial port. Route all User Messages to the SMS Destination Address 8 = Route Incoming (Client to LMU) SMS messages to the host serial port. Route all User Messages to the last phone number that sent the LMU a message				**X**
138	**GSD Termination Timeout** *Description:* This S-Register controls the length of time the LMU will wait for a User Message to either receive the termination character or reach the max termination length. If this time elapsed and there is data, a User Message is sent *Settings:* The length of time in milliseconds the LMU will wait ranging from 1 to 255ms. A value of 0 disables this feature				**X**

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
139	**GPS Receiver – Special Functions** *Description:* This S-Register the settings of the LMU's internal GPS receiver *Settings:* Bit 0 – Bit 2: Receiver mode (Antaris Only) 0 = Default 1 = Stationary, but unknown 2 = Man-pack / walking 3 = Automotive / land vehicle 4 = At sea 5 = Airborne low dynamics 6 = Airborne medium dynamics 7 = Airborne high dynamics Bit 4 – SBAS - Set = Enable SBAS Mode - Cleared = Disable SBAS Mode Bit 5 – Elevation Filter - Set = Enables a 15 degree elevation filter - Cleared = Enables a 5 degree elevation filter Bit 6 – Not Used Bit 7 – Update rate (LMU-2500/4100 Only) - Set = Enables 4Hz updates - Cleared = Enables 1 Hz updates	**1.1d**	**X**	**X**	**X**

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
140	**Unit Configuration Controls** *Description:* This S-Register controls some of the advanced settings of the LMU's *Settings:* Bit 0 – A/D Scaling - Set = Forces the A/D to use a 38.5mV per division scaling on its readings - Cleared = Forces the A/D to use a 1mV per division scaling on its readings Bit 1 – User Message Format - Set = The LMU will use the LM Direct User Message With Accumulators format - Cleared = The LMU will use the LM Direct User Message format Bit 2 – Mobile ID reporting - Set = The Mobile ID Type will not appear in the Options Header for messages created by the LMU - Cleared = The mobile ID Type will appear in the Options Header for messages created by the LMU Bit 3 – LED Enables - Set = Disable the Comm and GPS Status LEDs - Cleared = Enable the Comm and GPS Status LEDs Bit 4 – Inbound Reporting Format - Set = Use the LM Direct Message Format - Cleared = Use the LM eXchange Message Format Bit 5 – Log Mode Enable - Set = The LMU's log is in batch mode on a cold boot - Cleared = The LMU's log is in store and forward mode on a cold boot Bit 6 – Expansion Interface Power down Enable (clear) /Disable (set) Sleep power down of expansion interface (set = do not power down) - Set = Do not power down the expansion interface when the LMU goes to sleep. NOTE this will increase the sleep current draw. - Cleared = The expansion port is powered down when the LMU goes to sleep Bit 7 – Data Session Initialization - Set = A data session is not attempted with the LMU is powered up - Cleared = A data session is initialized when the LMU is powered up	**X**	**X**	**X**	**X**

Copyright ©CalAmp DataCom Inc 2009

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
141	**GSD (User) Serial Port Message Count Limit** *Description:* This S-Register counts the number of messages received on a serial port based on the Termination Character/Message Length/Etc… When the message count reaches the value of the S-Register, a User Message is created based on the last message received. *Settings:* The number of messages to ignore before creating a user message ranging from 0 – 127 messages. Bit 7 – Scaling - Set = the count is scaled by a factor of 100 (100-12700) - Cleared = The count is scaled by a factor of 1 (1-127)				**X**
142	**Horizontal Position Accuracy Threshold** *Description:* This value is used to help control the position used while the LMU is 'pinning'. The GPS accuracy estimate must be lower than this value for the LMU's position value to be updated. *Settings:* The accuracy limit to use, ranging from 1 to 255 meters. 0 Will disable this feature.	**X**	**X**	**X**	**X**
143	**Configuration Version** *Description:* This S-Register is reserved for use by the customer to Identify the Configuration Version seen in PULS. Users are advised not to change this setting locally. It should only be changed through PULS. *Settings:* Values can range from 0-255.	**X**	**X**	**X**	**X**
144	**GPS Restart Timer** *Description:* This is the length of time the LMU will wait before restarting the GPS receive if it does not have a valid GPS position. *Settings:* The amount of time to wait ranging from 0 to 255 minutes. .	**X**	**X**	**X**	**X**

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
145	**Mobile ID Type Selection** *Description:* This value specifies with mobile ID Type to use in the Options header of all Inbound messages. *Settings:* 0 = OFF/ No Mobile ID 1 = The Electronic Serial Number of the LMU (ESN) 2 = The serial number of the Modem (IMEI for GSM and iDEN devices, the ESN-Dec for CDMA devices) 3 = The subscriber identifier (IMSI for GSM and iDEN, the IMSI_T for CDMA) 4 = User Defined 5 = Phone Number 6 = IP Address	**X**	**X**	**X**	**X**
146	**Modem Baud Rate Override** *Description:* The S-Register determines which BAUD rate the LMU should use when talking to the wireless modem, either internal or external. This value will override the default values dictated by S-120. *Settings:* 4=4800 5=9600 7=19200 9=38400 (Default iDEN) 10=57600 (Default CDMA – Kyocera) 12= 115200 (Default GPRS, Default CDMA – WaveCom) 255 = use default				**X**
147	**Vehicle Class Identifier** *Description:* This S-Register is reserved for use by the customer to Identify the Vehicle Class Value seen in PULS. *Settings:* Values can range from 0-255.	**X**	**X**	**X**	**X**

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
148	**Host Port Baud Rate Selection** *Description:* The S-Register determines which BAUD rate the LMU should use for its Host Port while in Standard mode. This value will be overridden by S131 while in GSD mode *Settings:* 4=4800 5=9600 7=19200 9=38400 10=57600 12= 115200 255 = use default (115200)		**X**	**X**	**X**
149	**Send-Fail Modem Restart Count Threshold** *Description:* If the LMU is unable to send a message the number of times in this S-register, it will reset the wireless modem *Settings:* The number of Send Fails to wait before resetting the wireless modem ranging from 1 to 255. 0 disables this feature.	**X**	**X**	**X**	**X**
150	**Alternate Modem Select** *Description:* This S-Register controls which modem driver the LMU uses to connect to a wireless device when using Comm Index 1. Each driver decides what type of modem is being used for the LMU's data connectivity and if the LMU can poll the modem for network information (eg RSSI). The default Baud rate and Dial strings are also chosen by the driver. *Settings:* *LMU Drivers* 3 – **iDEN LMU** 19200, ATDT 0, PPP, Motorola iDEN Status – TC990569 5 – **GPRS LMU** 57600,ATD*99***1#, WaveCom 11 – **CDMA LMU** CDMA 1xRTT Modem – Kyocera M200 14 – **iDEN LMU** 19200, ATDT 0, PPP, CMUX Status – TC990599 15 – **GPRS LMU** 115200, ATD*99***1#, PPP, Siemens 17 - **CDMA LMU** CDMA 1xRTT Modem – WaveCom Q2438 18– **GPRS LMU** – ATD*99***1#, PPP, Siemens/Cinterion MC55				**X**

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
150 Cont…	*TetheredLocator Drivers* 128 – Generic 19200 BAUD, ATDT 0, No Status 129 – CDPD – Novatel Wireless NRM 6812 Series, 19200 BAUD ,AT\\ASLIP, MSCI Status 130 – CDPD – Novatel Wireless Expedite Series, 19200 BAUD ,AT\\APPP, MSCI Status 131 – iDEN - Motorola iDEN devices, 38400 BAUD, ATD0, RALP Status 132 – CDPD – Sierra Wireless MP200, 19200 BAUD, ATD0, No Status 133 – GSM/GPRS – WaveCom, 57600 BAUD, ATDT*99***#1, WMUX Status 134 – GSM/GPRS – Generic, 57600 BAUD, ATDT *99***#1, no Status 135 – CDPD – Ericsson R280d, 19200,BAUD, ATDT0, no Status 136 – TAIP Modem – 9600 BAUD, TAIP string sent directly to modem Serial port 137 – No Modem 139 – CDMA – Kyocera M200, 57600 BAUD, ATD#777, KMIP Status 140 – CDMA – Generic- 57600 BAUD, ATD#777, No Status 141 – TDMA – Sony Ericsson DM25, 9600 BAUD, (SMS Only), no Status 142 – iDEN – Motorola iDEN devices, 57600 BAUD, ATDT 0, CMUX Status 143 – GSM/GPRS – Siemens, 115200 BAUD, ATD*99***1#, PPP, Siemens 144 – Iridium Data Modem				X
151	**Reserved**				
152	**LCP Echo Interval** *Description:* This S-Register dictates how often the LMU will send an LCP Echo request to the wireless modem. If the modem does not respond 3 times in a row, the modem is reset. This does not apply to CDMA devices. *Settings:* The number of Send Fails to wait before resetting the wireless modem ranging from 1 to 255 second. 0 disables this feature.			X	X

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
153	**Polling Interval** *Description:* This is how often the LMU will poll the modem for network status information. The poll will only occur while the LMU is not attempting to transmit data. *Settings:* The number of seconds to wait between polls ranging from 1 to 255 seconds. 0 disables this feature.	X			X
154	**KMIP and Connection Monitor Control Register** *Description:* This S-Register controls the advanced KMIP settings and Connection Monitor Settings of the LMU. *Settings:* Bit 0 – KMIP Out of Data Call Disable - Set = Do not collect KMIP data when the data session is idle - Cleared = Allow KMIP data collection when the data session is idle Bit 1 = KMIP Mode Change Delay - Set = Enables a 2s delay when switching between KMIP and Data ports (required for early CDMA devices) - Cleared = No delay when switching between KMIP and Data ports Bit 2 = Connection Monitoring Send Enable (Does not apply to CDMA devices) - Set = Enables Connection Monitoring (LCP echo)activation when sending a packet - Cleared = Disables Connection Monitoring activation when sending a packet Bit 3 = Connection Monitoring Disable - Set = Disables Connection Monitoring - Cleared = Enables Connection Monitoring			X	X
155	**GSM Auto Provisioning Enable / Disable** *Description:* This S-Register will control if the LMU will automatically populate APN, Username and Password settings when a new operator ID is detected.. *Settings:* Bit 0 – Auto Provisioning - Set =Disables automatic provisioning of APN, Username and Password - Cleared = Enables auto-provisioning		X	X	X

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
156	**Position Update Controls** *Description:* This S-Register controls the advanced GPS behavior settings of the LMU. *Settings:* Bit 0 – Enable Pinning - Set = Enable Pinning when vehicle is not moving - Cleared = Disable Pinning Bit 1 = Ignition Enabled Pinning - Set = Ignore ignition to start/stop pinning - Cleared = Use ignition off to start/stop pinning Bit 2 = Enable NMEA RMC Message - Set = Replaces the Position update (POS) GPS string with an NMEA RMC message - Cleared = Uses POS GPS String only Bit 3 = External GPS Support - Set = The LMU will use an external source connected to the Host Port for GPS updates - Cleared = The LMU will use its internal GPS receiver for GPS updates	**X**	**X**	**X**	**X**
157	**Log Activity Comm Restart Timer** *Description:* This S-Register controls the length of time the LMU will wait after the log goes active before resetting the wireless modem. *Settings:* The length of time to wait ranging from 1 to 255 minutes. 0 disables this feature.	**X**	**X**	**X**	**X**

Copyright ©CalAmp DataCom Inc 2009

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
158	**Input Bias Configuration** *Description:* This S-Register controls setup of the inputs on the LMU and IOPod. *Settings:* Bit 1 – GPIO1 – Input Bias - Set = High (Vcc) Bias) - Cleared = Low (Gnd) Bias) Bit 2 – GPIO2 – Input Bias - Set = High (Vcc) Bias) - Cleared = Low (Gnd) Bias) Bit 3 – Input 3 – Input Bias - Set = High (Vcc) Bias) - Cleared = Low (Gnd) Bias) Bit 4 – Input 4 – Input Bias - Set = High (Vcc) Bias) - Cleared = Low (Gnd) Bias) Bit 5 – Input 5 – Input Bias - Set = High (Vcc) Bias) - Cleared = Low (Gnd) Bias) Bit 6 – Input 6 – Input Bias - Set = High (Vcc) Bias) - Cleared = Low (Gnd) Bias) Bit 7 – Input 7 – Input Bias - Set = High (Vcc) Bias) - Cleared = Low (Gnd) Bias)	**X**	**X**	**X**	**X**
159	**GPIO Function Selection** *Description:* This S-Register controls setup of the GPIO (General Purpose Input/Output) lines on the LMU and IOPod. *Settings:* Bit 0 – GPIO 1 Function - Set = Configure GPIO 1 to be an output. Input function disabled - Cleared = Configure GPIO1 to be and input Bit 1 – GPIO 2 Function - Set = Configure GPIO 2 to an output. Input function disabled - Cleared = Configure GPIO 2 to be an input		**X**		**X**

Copyright ©CalAmp DataCom Inc 2009

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
160	**Aux Serial Port Mode Control** *Description:* This S-Register controls what mode the LMU's Aux port is in. *Settings:* 0 = Generic Serial Device (GSD) 1 = Enabled NMEA GGA Message Output Bit 4 – RMC Message - Set = Enable NMEA RMC message output - Cleared = Disable NMEA RMC message output				**X**
161	**Aux Serial Port Baud Rate** *Description:* This S-Register will set the LMU's Host Port Baud rate while not in Standard mode *Settings:* 4 = 4800 5 = 9600 7 = 19200 9 = 38400 10 = 57600 12 = 115200				**X**
162	**Aux Serial Port Word Definition** (Parity, Stop Bits, Word Size) *Description:* This S-Register will set the LMU's Host Port word definition while not in Standard mode *Settings:* Bit 0 – Bit 1 – Word Size 0 = 5 bits 1 = 6 bits 2 = 7 bits 3 = 8 bits Bit 2 – Stop Bits - Set = 2 Stop Bits - Cleared = 1 Stop Bit Bit 3 – Parity - Set = Parity Enabled - Cleared = No Parity Bit 4 – Parity Type - Set = Even Parity - Cleared = Odd Parity				**X**

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
163	**Aux Serial Port Misc. Controls** *Description:* This S-Register will set the LMU's Host Port behavior while not in Standard mode *Settings:* Bit 2 - Termination Character - Set = Enables the use of the termination character for User Message creation - Cleared = Disables the use of the termination character for User Message creation				**X**
164	**Aux Serial Port GSD(User) Message Termination Character** *Description:* This S-Register will set the Termination Character to be used to end a user message *Settings:* Decimal value of the ASCII Character ranging from 0 -255.				**X**
165	**Aux Serial Port GSD(User) Message Termination Length** *Description:* This S-Register controls the maximum length of a User Message. *Settings:* The size of the user message ranging from 4 to 804 bytes. The S-register has an LSB of 4 bytes, so it will range from 0(4bytes) to 201 (804 bytes).				**X**
166	**Aux Serial Port GSD (User) Message Type** *Description:* This S-Register controls the User Message ID value assigned to any User Message sent by the LMU. It is also used by the LMU to match against incoming User Messages. The User Message ID of the incoming User Message must match the value contained in this S-Register in order for it to be passed to the Aux Port. *Settings:* User Message ID values can range from 0 to 255.				**X**

Copyright ©CalAmp DataCom Inc 2009

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
167	**Aux Serial Port GSD(User) Message Disposition** *Description:* This S-Register controls the Disposition of the User Message. *Settings:* 1 = Send Message, Log if Send Fails 2 = Send Message, Log if Send Fails 3 = Log Message 4 = Priority Message 5 = Unacknowledged Message 7 = Route Incoming (Client to LMU) SMS messages to the Aux serial port. Route all User Messages to the SMS Destination Address 8 = Route Incoming (Client to LMU) SMS messages to the Aux serial port. Route all User Messages to the last phone number that sent the LMU a message				**X**
168	**Aux Serial Port GSD Termination Timeout** *Description:* This S-Register controls the length of time the LMU will wait for a User Message to either receive the termination character or reach the max termination length. If this time elapsed and there is data, a User Message is sent *Settings:* The length of time in milliseconds the LMU will wait ranging from 1 to 255ms. A value of 0 disables this feature				**X**
169	**Aux Serial Port GSD (User) Serial Port Message Count Limit** *Description:* This S-Register counts the number of messages received on a serial port based on the Termination Character/Message Length/Etc… When the message count reaches the value of the S-Register, a User Message is created based on the last message received. *Settings:* The number of messages to ignore before creating a user message ranging from 0 – 255 messages.				**X**

Copyright ©CalAmp DataCom Inc 2009

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
170	**BlueLocator Configuration Settings** *Description:* This S-Register controls the settings of the BlueLocator's Bluetooth Adapter (BTA). *Settings:* Bit 0 & Bit 1 – Bluetooth Mode Control 0 = Not Active 1 = Set the BTA as the BlueLocator's Host Port 2 = Set the BTA as the BlueLocator's external Modem Port 3 = Reserved Bit 2 - Set = The BTA is discoverable and can be connected to - Cleared = The BTA is not discoverable and cannot be connected to Bit 3 - Set = The BTA will attempt to connect to the remote device - Cleared = The BTA will not attempt to connect to a remote device Bit 4 - Set = The BTA will use the Bluetooth Dial Up Networking Profile - Cleared = The BTA will use the Bluetooth Serial Port Profile Bit 5 - Set = The BTA is in low security mode (i.e. it does not require a PIN to be paired to) - Cleared = The BTA is in normal security mode (i.e. a PIN is required for every new pairing)				**X**

Copyright ©CalAmp DataCom Inc 2009

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
171	**Unit Configuration Settings** *Description:* This S-Register controls some of the advanced configuration settings of the LMU. *Settings:* Bit 0 – 1-Bit Bus - Set = Enables 1 Bit Bus operations but disables Output-0 controls - Cleared = disables 1 Bit Bus operations. Bit 1 – RESERVED Bit 2 – Radio Sleep - Set = The LMU will leave the modem on when it goes to sleep to allow the LMU to wake up via an SMS message - Cleared = The modem will be powered off when the LMU goes to sleep Bit 3 – LED Blink Controls - Set = LEDs will blink according to the Input Code pattern instead of the Comm and GPS patterns - Cleared = LEDs will blink according to the Comm and GPS patterns Bit 4 – AT Command Password Protection - Set = The LMU will only respond to AT Commands if a password is entered first. - Cleared = The LMU will respond to AT Command without entering a password Bit 5 – LED Alternate Blink Code - Set = LEDs will blink according to the Input Code pattern instead of the Comm and GPS patterns if Bit 3 is also set - Cleared = LEDs will blink according to the Comm and GPS patterns Bit 6 – 1 Bit Bus Temperature Sensor (LMU-2500 Only) - Set = The 1 Bit Bus is configured for a temperature sensor. - Cleared = The 1-Bit Bus is configured for an ID tag	**X**	**X**	**1.0j**	**X**
172	**PDP Context Timeout** *Description:* This S-Register controls the length of time the LMU will wait after the last data active before resetting the PDP Context session modem. *Settings:* The length of time to wait ranging from 1 to 255 minutes. 0 disables this feature.	**X**	**X**	**X**	**X**

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
173	**Serial Message Configuration** *Description:* This S-Register controls the serial message settings for use with the Serial Message PEG Action. The control is split into two parts, the protocol (bits 0-4) and the port (bits 5-7). *Settings:* Bit 0 – 4-Protocol - 1 = Mackenzie Lab's DADS-A1214 In-Vehicle Automation System - 2 – Garmin NUVI - 0, 3-31 = Reserved Bit 5 – 7 Serial Port Selection - 0 = Host Port - 1 = Modem Port - 2 = Aux Port - 3 = SMS Destination Address - 4 – 7 = Reserved				**X**
174	**GPS Fix Quality Threshold** *Description:* This S-Register controls the GPS Fix Quality Threshold used by the LMU for pinning, moving/not moving detect and the GPS Fix Quality PEG Condition. *Settings:* Bit 0 – 2-Thresholds - 0 = Threshold Off - 1 = Sat Count >= 4 and HDOP <= 3.0 - 2 = Sat Count >= 4 and HDOP <= 2.0 - 3 = Sat Count >= 5 and HDOP <= 2.0 - 4 = Sat Count >= 5 and HDOP <= 1.5 - 5 = Sat Count >= 6 and HDOP <= 1.5 - 6 = Sat Count >= 7 and HDOP <= 1.5 - 7 = Sat Count >= 8 and HDOP <= 1.2 Bit 3 – 7 Reserved	**1.2k**		**1.1a**	**8.4a**
175	**Motion Detect Filter – HPF and Threshold** *Description:* This S-Register controls the width of the High Pass Filter and Threshold used to detect movement.. *Settings:* Bit 0 – 3-Thresholds - 0 – 15 (default of 3) Bit 4 – 6 High Pass Filter Width - 0 = HPF Off (Default setting) - 1 = 2 Hz - 2 = 1 Hz - 3 = 0.5Hz - 4 = 0.25Hz Bit 7 Reserved	**X**		**X**	

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Register	Description	8-Bit	LMU-1000™	LMU-2500™	LMU-4100™
176	**Motion Detect Filter – Duration** *Description:* This S-Register controls the minimum length of time the LMU uses to detect motion. (i.e. the LMU must be moving for at least S176S). *Settings:* The minimum length of time the LMU must be moving to detect movement with its motion sensor. The field uses a 10ms LSB so a value of 67 = 670mS. - 0-255 (0mS to 2550mS)	X		X	

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

APPENDIX C – ASCII CHART

Hexadecimal to ASCII

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	NUL	SOH	STX	ETX	EOT	ENQ	ACK	BEL	BS	HT	LF	VT	FF	CR	SO	SI
1	DLE	DC1	DC2	DC3	DC4	NAK	SYN	ETB	CAN	EM	SUB	ESC	FS	GS	RS	US
2	SP	!	“	#	$	%	&	‘	(	)	*	+	,	-	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
6	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	DEL

Decimal to ASCII

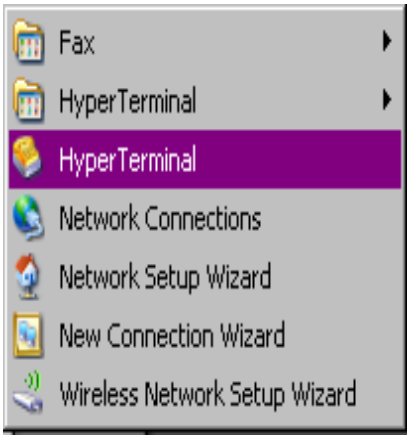
Dec	Char	Dec	Char	Dec	Char	Dec	Char
0	NUL	32	Sp	64	@	96	`
1	SOH	33	!	65	A	97	a
2	STX	34	“	66	B	98	b
3	ETX	35	#	67	C	99	c
4	EOT	36	$	68	D	100	d
5	ENQ	37	%	69	E	101	e
6	ACK	38	&	70	F	102	f
7	BEL	39	‘	71	G	103	g
8	BS	40	(	72	H	104	h
9	TAB	41	)	73	I	105	i
10	LF	42	*	74	J	106	j
11	VT	43	+	75	K	107	k
12	FF	44	,	76	L	108	l
13	CR	45	-	77	M	109	m
14	SO	46	.	78	N	110	n
15	SI	47	/	79	O	111	o
16	DLE	48	0	80	P	112	p
17	DC1	49	1	81	Q	113	q
18	DC2	50	2	82	R	114	r
19	DC3	51	3	83	S	115	s
20	DC4	52	4	84	T	116	t
21	NAK	53	5	85	U	117	u
22	SYN	54	6	86	V	118	v
23	ETB	55	7	87	W	119	w
24	CAN	56	8	88	X	120	x
25	EM	57	9	89	Y	121	y
26	SUB	58	:	90	Z	122	z
27	ESC	59	;	91	[	123	{
28	FS	60	<	92	\	124	|
29	GS	61	=	93	]	125	}
30	RS	62	>	94	^	126	~
31	US	63	?	95	_	127	DEL

Copyright ©CalAmp DataCom Inc 2009

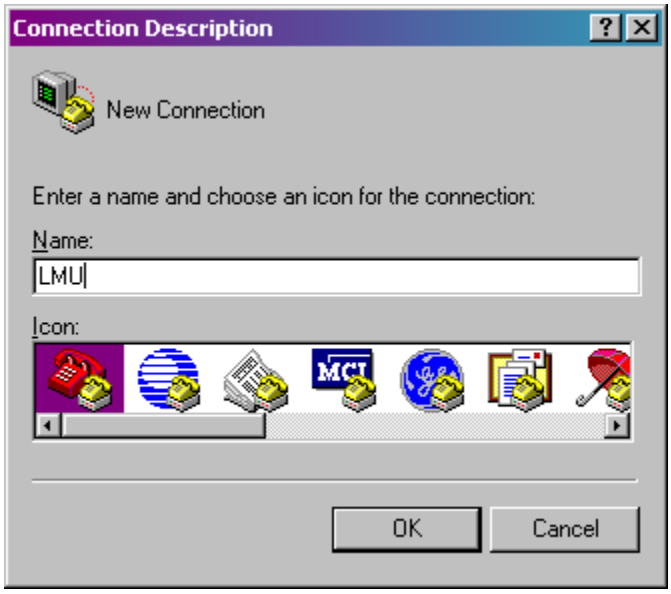
CalAmp Proprietary & Confidential

APPENDIX D – HYPERTERMINAL SETUP

Click the **Start** button and go to **Programs, Accessories** and **Communications.**
Click the **Hyper Terminal** icon**.**



This should display a new connection wizard.

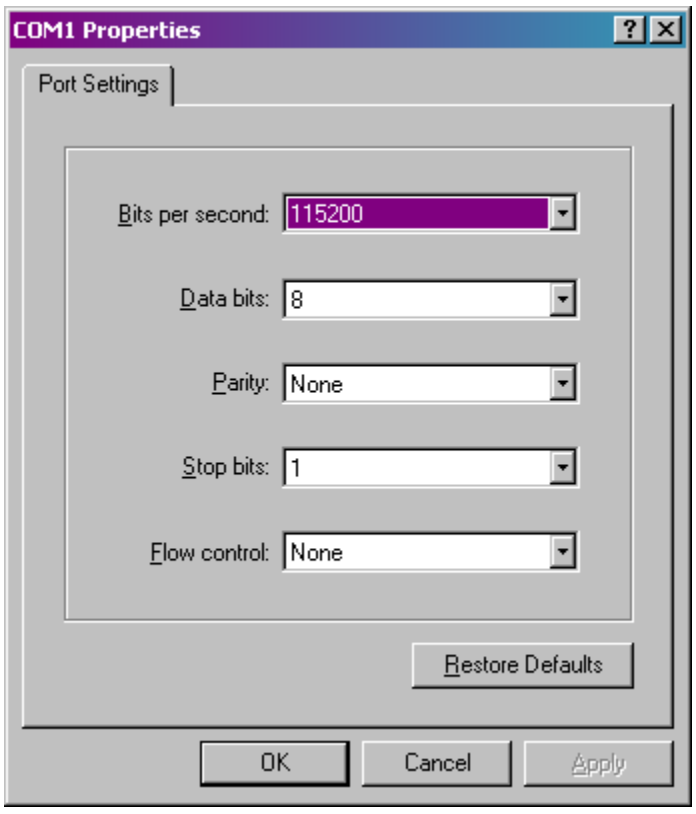


Name the connection **LMU**
Click **OK**.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Change *Connect using* field to read **Direct to ComX**, where X is the Com port that the LMU is attached to.
Click **OK**.



Change *Bits per second* to read **115200**.
Click **OK**.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

The wizard should now close and a cursor should appear in the main HyperTerminal window. It is a good idea to verify that communications are established with the LMU. This can be done by issuing the following AT Command:

```
ATI0
```

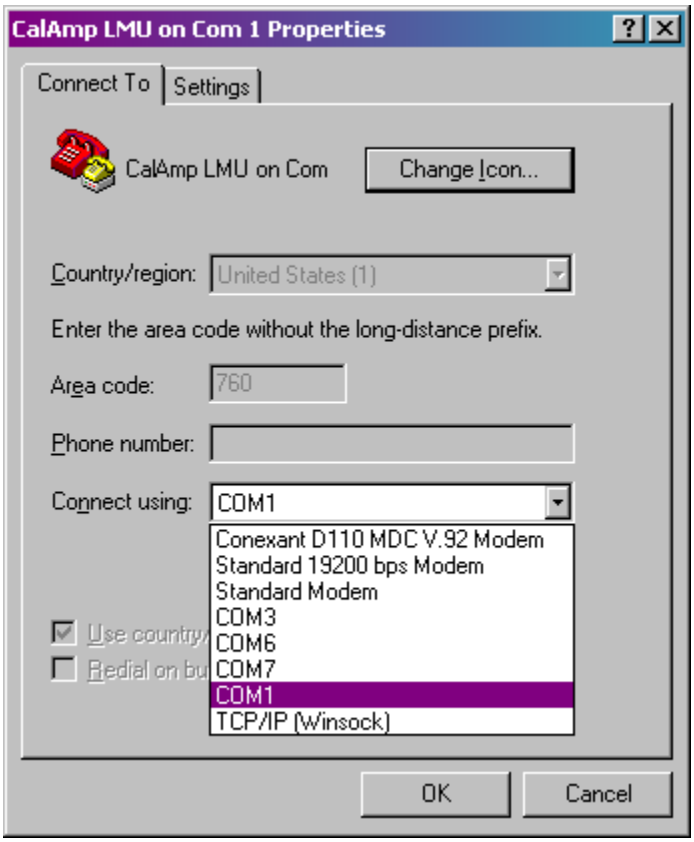
A response similar to the following should appear:

```
APP:LMU,001 V8.0b (Sep 26 2007 18:10:32)
PIC:TIM S/N 4130000200
GPS:UBLOX-00040001 -5.00    Jan 09 2006 12:00:00
Radio:SIEMENS TC65-REVISION 02.000
```

If another response appears it is a good chance that HyperTerminal is connected to the wrong Com Port. The com port setting can be changed by the following sequence.

Click the **Call** menu then select **Disconnect**.
From the **File** menu click **Properties**.

The Com Port can be changed by altering the *Connect Using* entry and clicking **OK**.



To reconnect HyperTerminal to the LMU select **Call** from the **Call** menu.

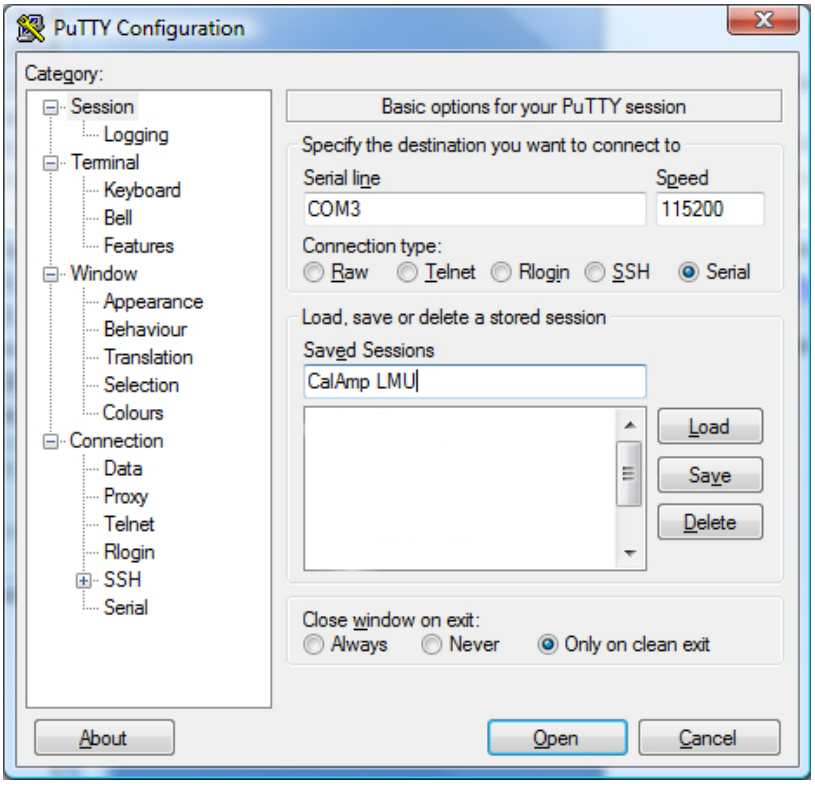
Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Appendix E - Windows Vista – Putty Setup

Microsoft stopped including the HyperTerminal program as part of its offering with Windows Vista. As a result you will need to find an alternate program to communicate directly with the LMU. One option is to purchase HyperTerminal from Hilgraeve (http://www.hilgraeve.com/hyperterminal.html). Alternatively you can use a terminal emulation program such as PuTTY. (http://www.chiark.greenend.org.uk/~sgtatham/putty/).
The following instructions describe how to configure PuTTY for use with the CalAmp LMU.

1. Download and save the PuTTY.exe file to your PC.
2. Launch the PuTTY.exe file
3. Change the *Connection type* to **Serial**
4. Change the *Speed* to **115200**
5. Change the *Serial Line* field to **COM<x>** where <x> is the port the LMU is connected to.
6. In the *Saved Sessions* field enter **CalAmp LMU**

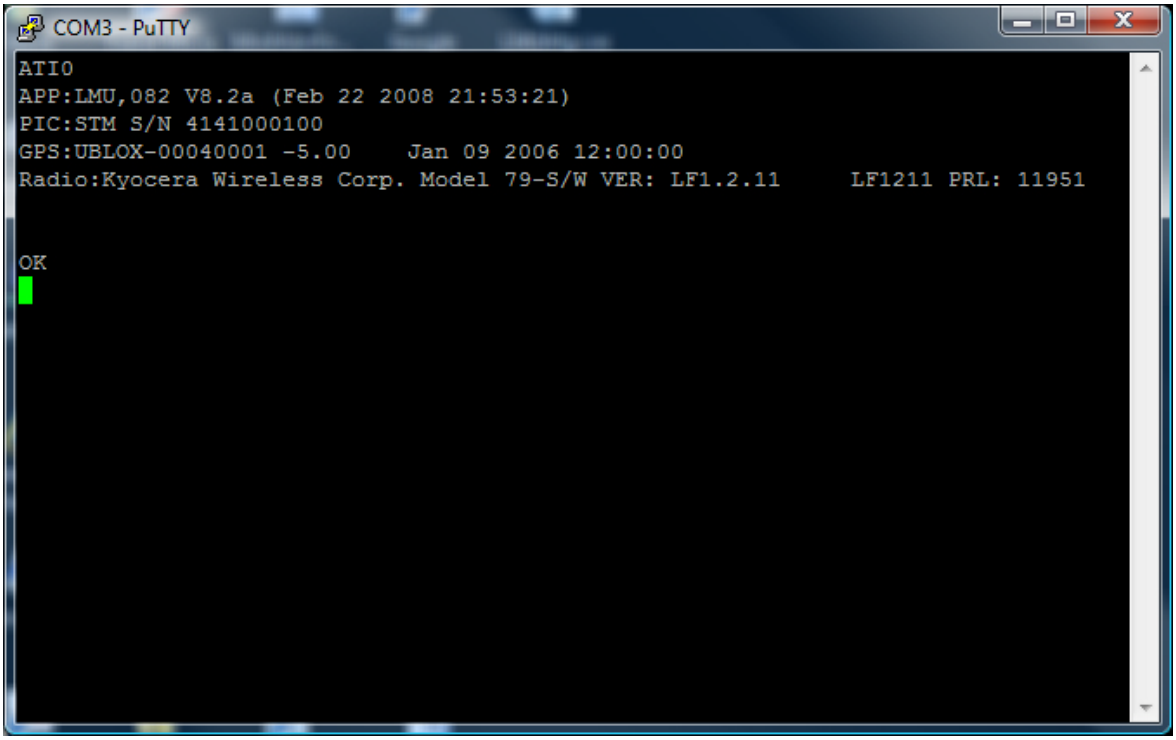


7. Click **Save**
8. Make sure the LMU is connected and powered on and then click **Open**

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

9. To test the connection, enter the AT Command **ATI0.** (Note, if you cannot see what you are typing, enter a second AT Command of **ATE1**
10. You should see a response similar to the following:


COM3 - PuTTY
ATI0
APP:LMU,082 V8.2a (Feb 22 2008 21:53:21)
PIC:STM S/N 4141000100
GPS:UBLOX-00040001 -5.00 Jan 09 2006 12:00:00
Radio:Kyocera Wireless Corp. Model 79-S/W VER: LF1.2.11 LF1211 PRL: 11951
OK

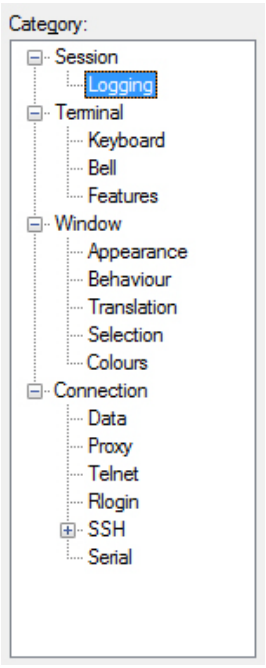
Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Logging data to file with PuTTY

To start capturing LMU responses to file you can use the logging setup in PuTTY. This is done as follows:

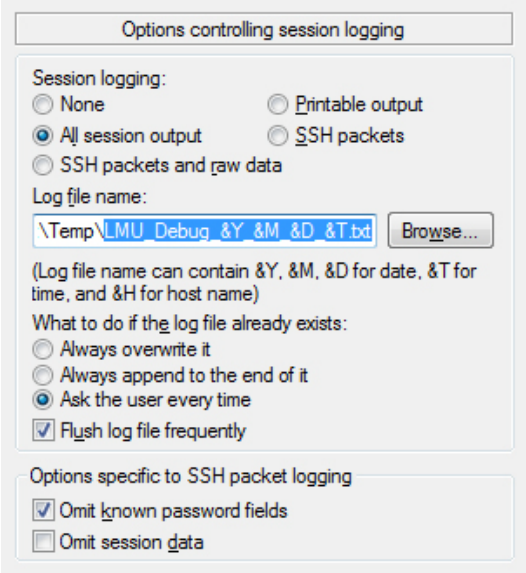
1. Launch the PuTTY.exe file
2. From the *Saved Sessions* list select **CalAmp LMU** and click **Load**
3. From the *Category* list expand **Session** and click **Logging**



4. Under *Session logging* select **All session output**
5. For *Log file name* enter **<Some directory>\ LMU_Debug_&Y_&M_&D_&T.txt** where <some directory> is a know good directory path. (For example C:\Temp\)

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential


Options controlling session logging
Session logging:
None
Printable output
All session output
SSH packets
SSH packets and raw data
Log file name:
\Temp\LMU_Debug_&Y_&M_&D_&T.txt
Browse...
(Log file name can contain &Y, &M, &D for date, &T for time, and &H for host name)
What to do if the log file already exists:
Always overwrite it
Always append to the end of it
Ask the user every time
Flush log file frequently
Options specific to SSH packet logging
Omit known password fields
Omit session data

6. Under *Categories* select **Session**
7. Click **Save**

This will create a file called LMU_Debug_YYYY_MM_DD_HH:MM:SS.txt every time you open the session where YYYY is the current year, MM is the current month, DD is the current day and HH:MM:SS is the current time.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Appendix F - Pairing to the LMU-4100 Using Windows Mobile

To pair the LMU-4100™ using a BTA with a Windows Mobile device you would perform the following steps:

1. Go to **Start** -> **Settings** and click the **Connections** tab.
2. Tap the **Bluetooth** icon.
3. In the **Mode** tab, check both the *Turn on Bluetooth* and *Make this device discoverable to other devices* options.
4. Under devices, delete any existing connections
5. Tap **New Partnership...**
6. Select **LMU xx.xx.xx** from the list that appears. (If a list doesn't appear, hit **Refresh**)
7. Tap **Next**
8. Enter the LMU's passkey (likely '0000') and tap **Next**
9. When you're asked to connect to the LMU, tap **Yes**
10. Re-enter the passkey if needed
11. Select **Serial Port** from the *Select services to use from this device*
12. Tap **Finish**
13. Tap the **COM Ports** tab.
14. Tap **New Outgoing Port**
15. Select the LMU from the devices list and tap **Next**
16. Select the COM port you wish to use. (For example I'm using COM0)
17. Un-check the **Secure Connection** option[28]

[28] This will prevent you from having to rebuild most of this connection the next time you want to pair to the same BTA.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Appendix G - Adding a Modem Driver

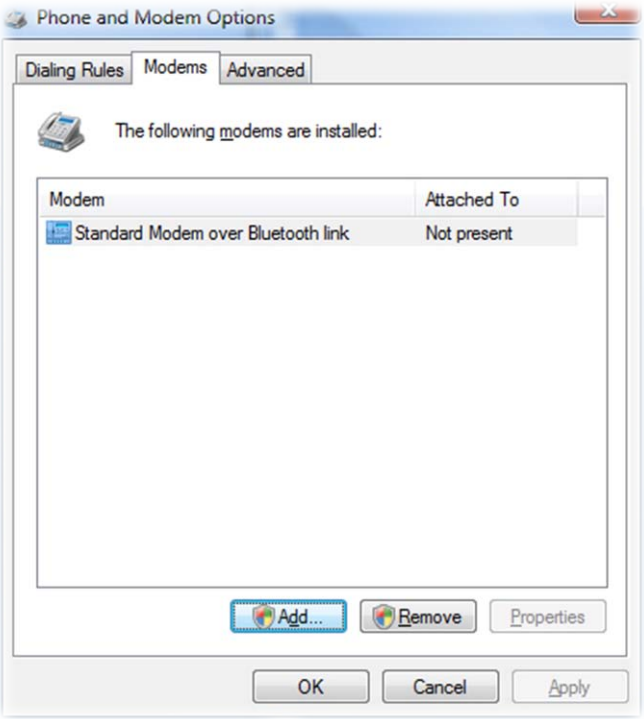
In order to use the LMU-4100™ as a modem you may need to add a new modem driver so that your operating system will recognize it as a valid device. The following sections describe how to do this on a common laptop based operating system and a common PDA operating system. You may need to refer to your operating system's documentation for further details.
Adding a Modem Driver

Windows Vista

This set of instructions assumes you are using the 'Classic' view of the Control Panel. They also assume that there is a serial port available on your PC or Laptop. In many cases, this may require purchasing and installing a USB to Serial adapter.

1. Go to **Start**, **Settings**, and click **Control Panel.**
2. Open the **Phone and Modem Options** control.

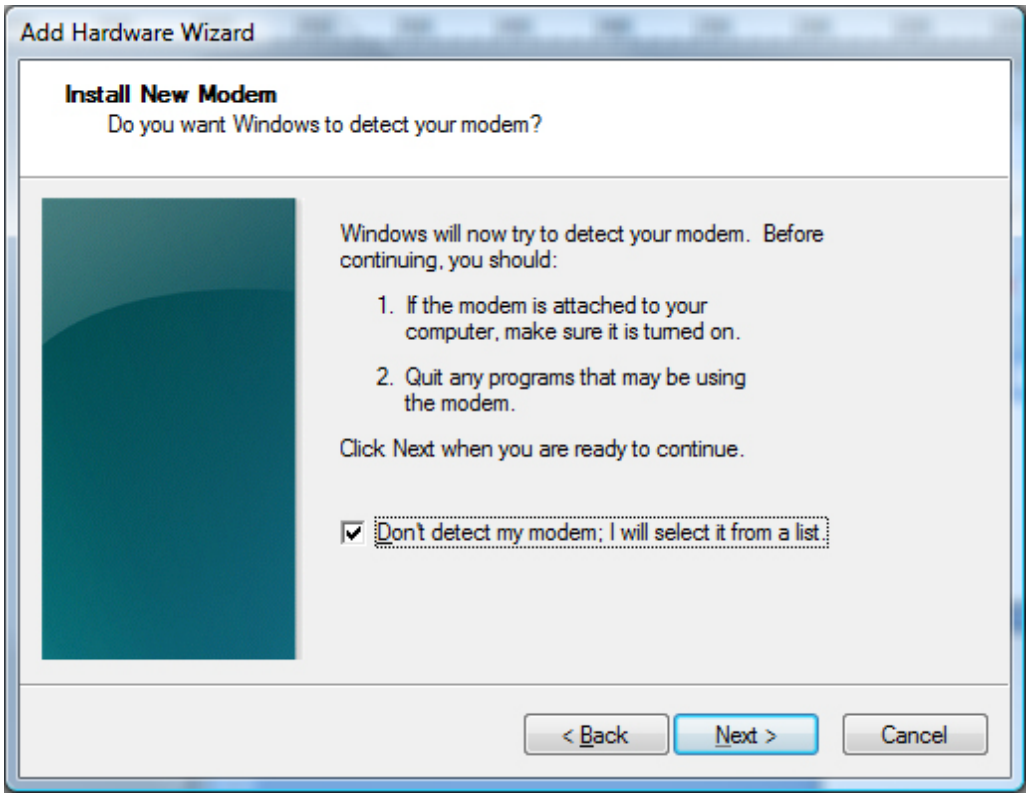
3. Click the **Modems** tab.



4. Click the **Add…** button

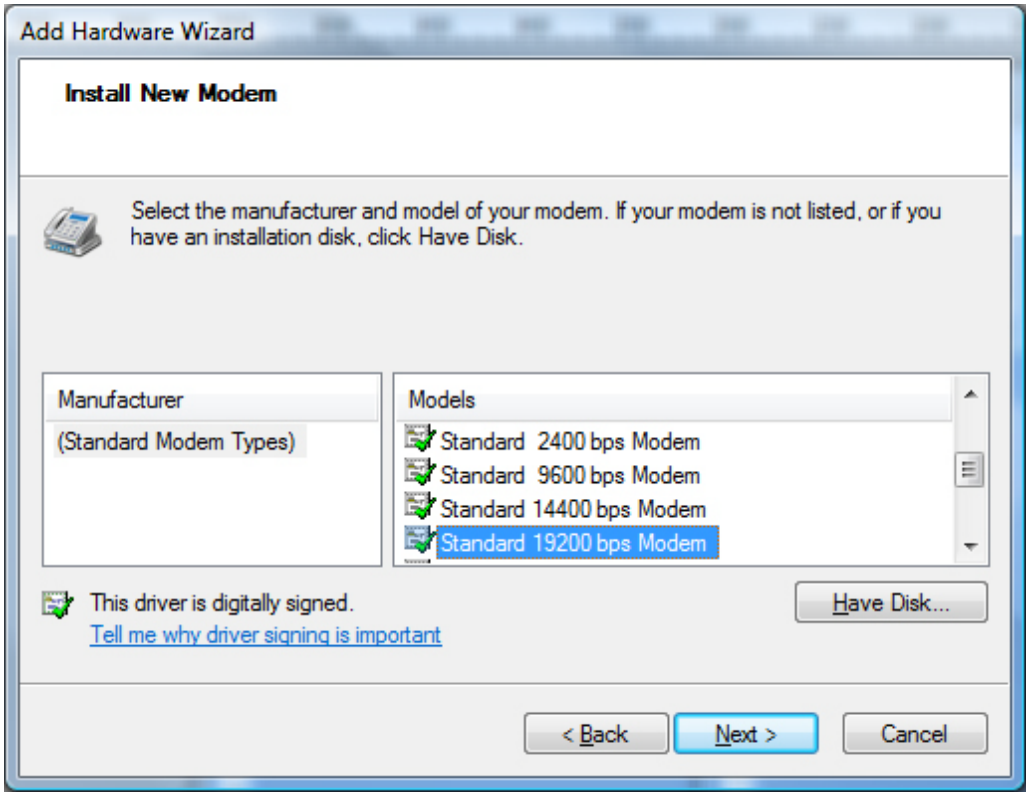
Copyright ©CalAmp DataCom Inc 2009

5. Click the **Continue** button
6. Check the **Don't detect my modem; I will select it from a list** option and click the **Next >** button.


Add Hardware Wizard
Install New Modem
Do you want Windows to detect your modem?
Windows will now try to detect your modem. Before continuing, you should:
1. If the modem is attached to your computer, make sure it is turned on.
2. Quit any programs that may be using the modem.
Click Next when you are ready to continue.
Don't detect my modem; I will select it from a list.
< Back
Next >
Cancel

7. Under *Manufacturer* select **(Standard Modem Types)**
8. Under *Models* select **Standard 19200 bps Modem**

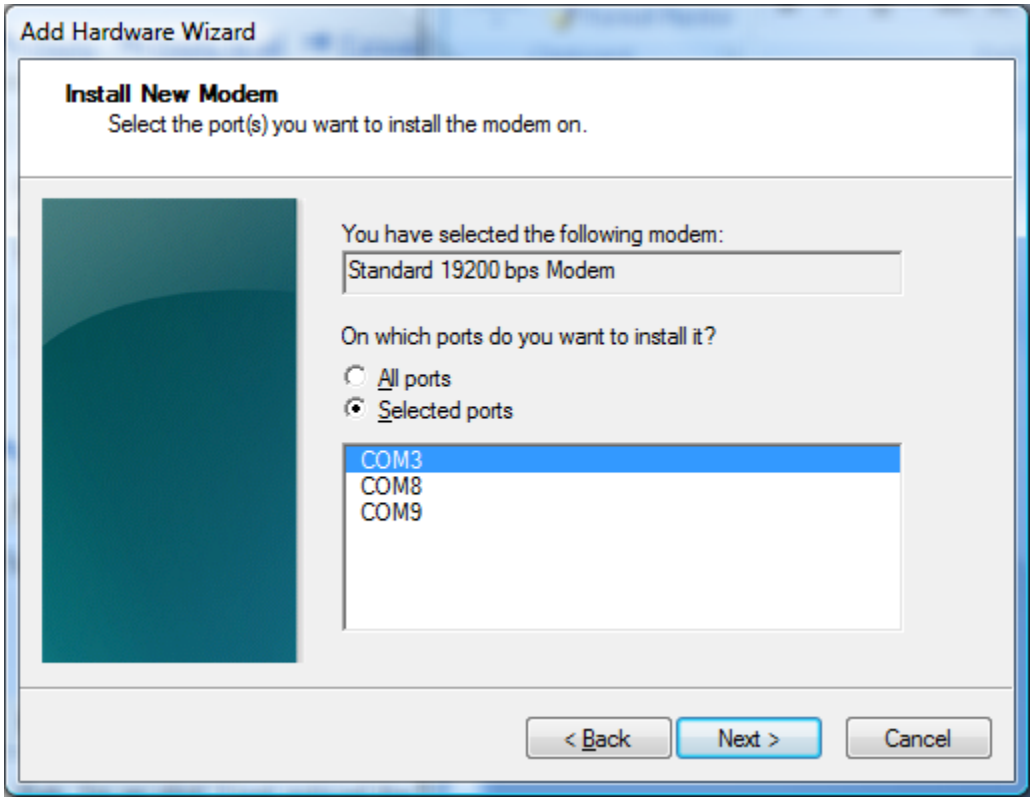
Copyright ©CalAmp DataCom Inc 2009


Add Hardware Wizard
Install New Modem
Select the manufacturer and model of your modem. If your modem is not listed, or if you have an installation disk, click Have Disk.
Manufacturer
(Standard Modem Types)
Models
Standard 2400 bps Modem
Standard 9600 bps Modem
Standard 14400 bps Modem
Standard 19200 bps Modem
This driver is digitally signed.
Tell me why driver signing is important
Have Disk...
< Back
Next >
Cancel

9. Click **Next >**.
10. Click the **Selected Ports** option and then choose the COM Port the LMU-4100 is connected to. If you are plugged into the back of your laptop, this will generally be COM 1. If you are using a USB to Serial Adapter or a Bluetooth device with a Serial Port Profile it will likely be COM 5 or higher. In the example below, the USB to Serial adapter is on COM3:

Copyright ©CalAmp DataCom Inc 2009

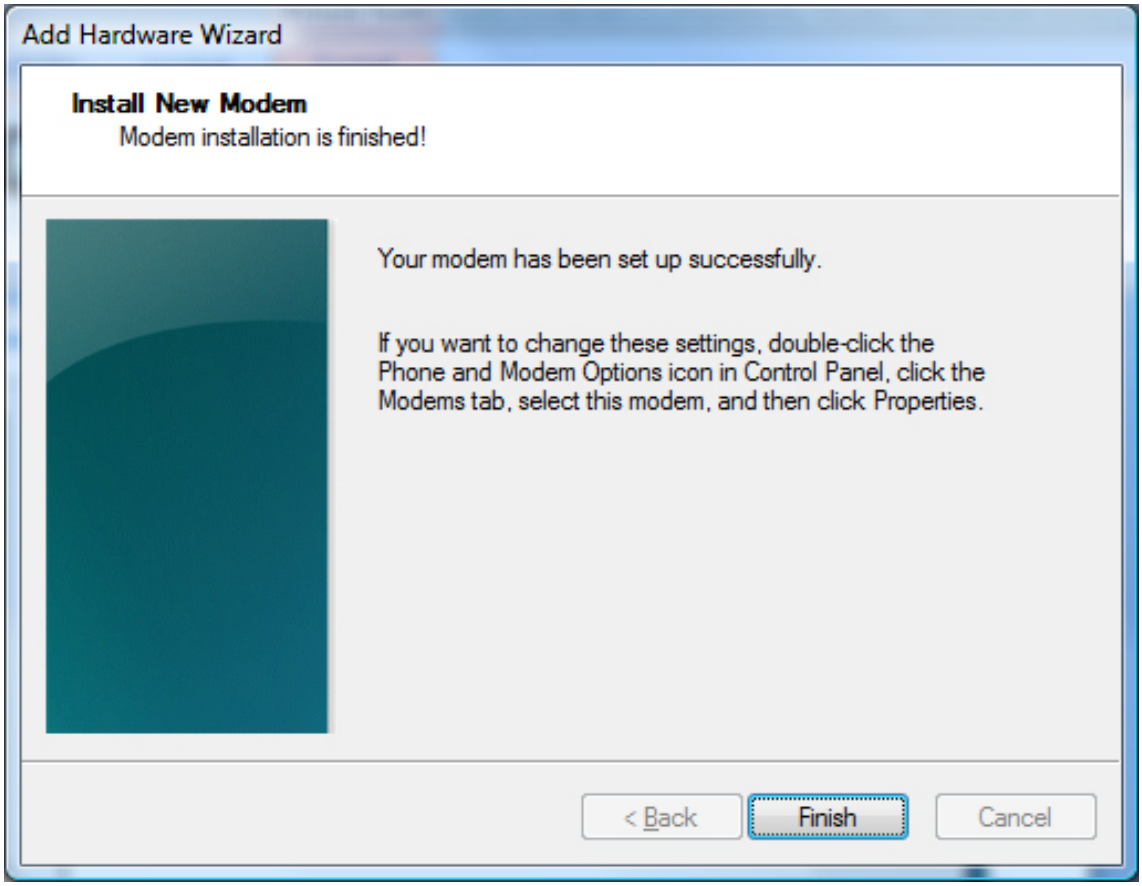
CalAmp Proprietary & Confidential



11. Click **Next >**.
12. When you see that the modem installation has been successful, click **Finish**

Copyright ©CalAmp DataCom Inc 2009

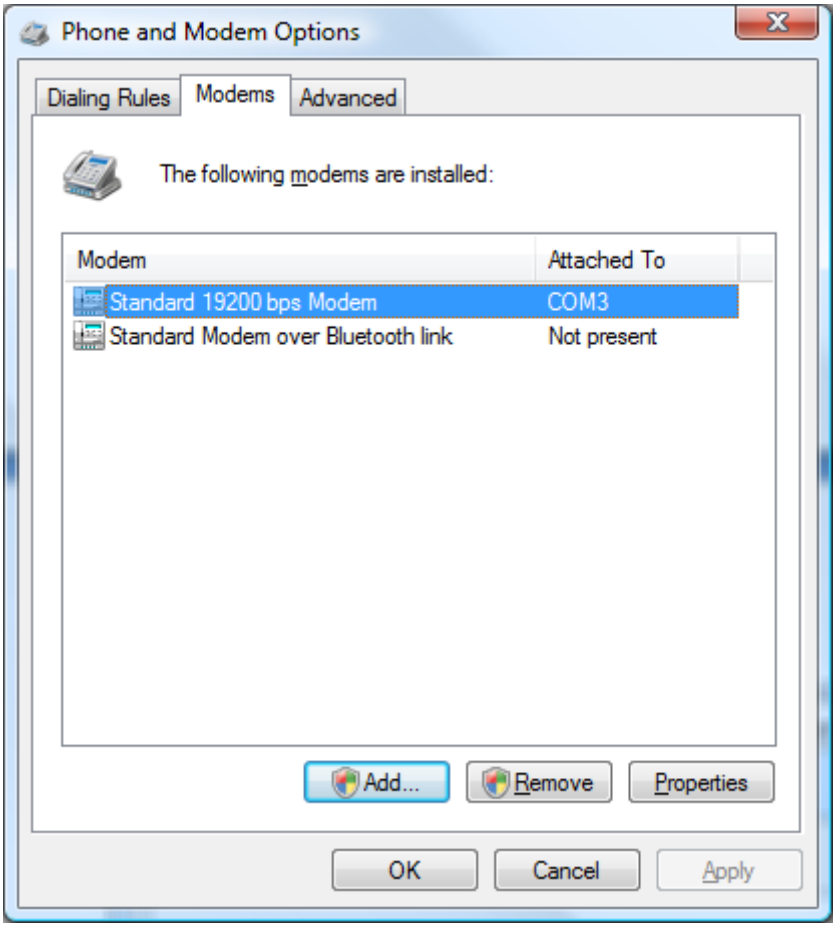
CalAmp Proprietary & Confidential


Add Hardware Wizard
Install New Modem
Modem installation is finished!
Your modem has been set up successfully.
If you want to change these settings, double-click the Phone and Modem Options icon in Control Panel, click the Modems tab, select this modem, and then click Properties.
< Back
Finish
Cancel

13. From here you will need to set the Maximum Port speed to 115200 BAUD for use with the LMU-4100. To do this, highlight the *Standard 19200 bps modem* and click **Properties.**

Copyright ©CalAmp DataCom Inc 2009

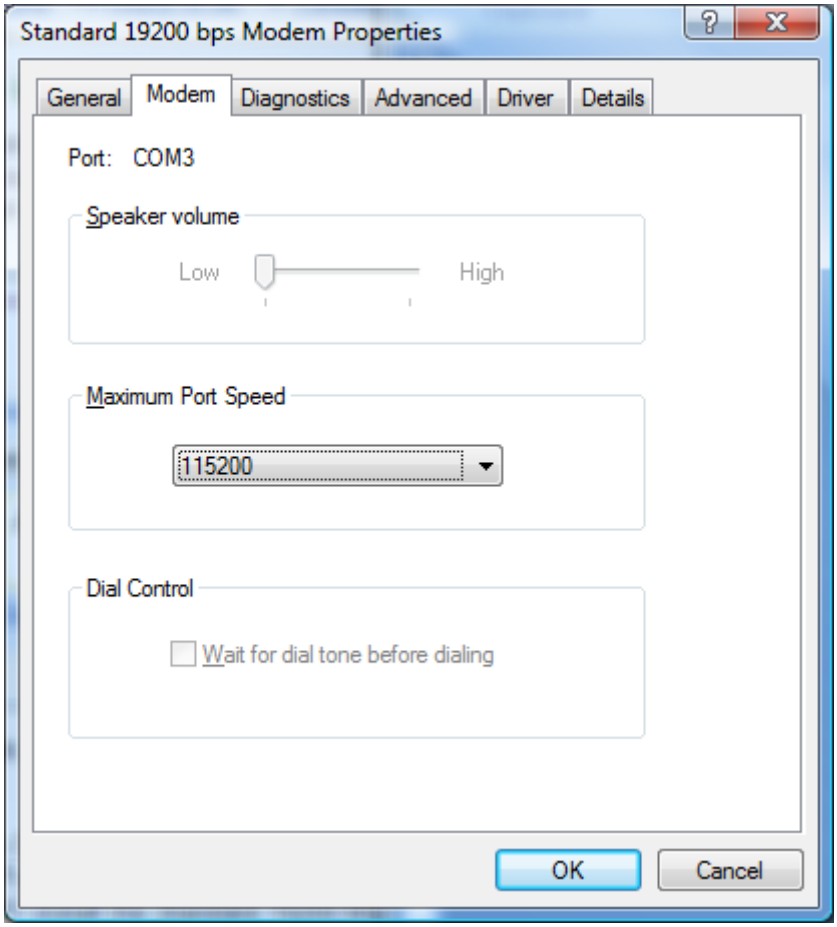
CalAmp Proprietary & Confidential



14. Click the **Change** Settings button.
15. Click the **Continue** button.
16. Click the **Modem** tab.
17. Change the *Maximum Port Speed* value to be 115200.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential



18. Click **OK** to exit back to the main control panel.
19. Click **OK** to finish.

Copyright ©CalAmp DataCom Inc 2009

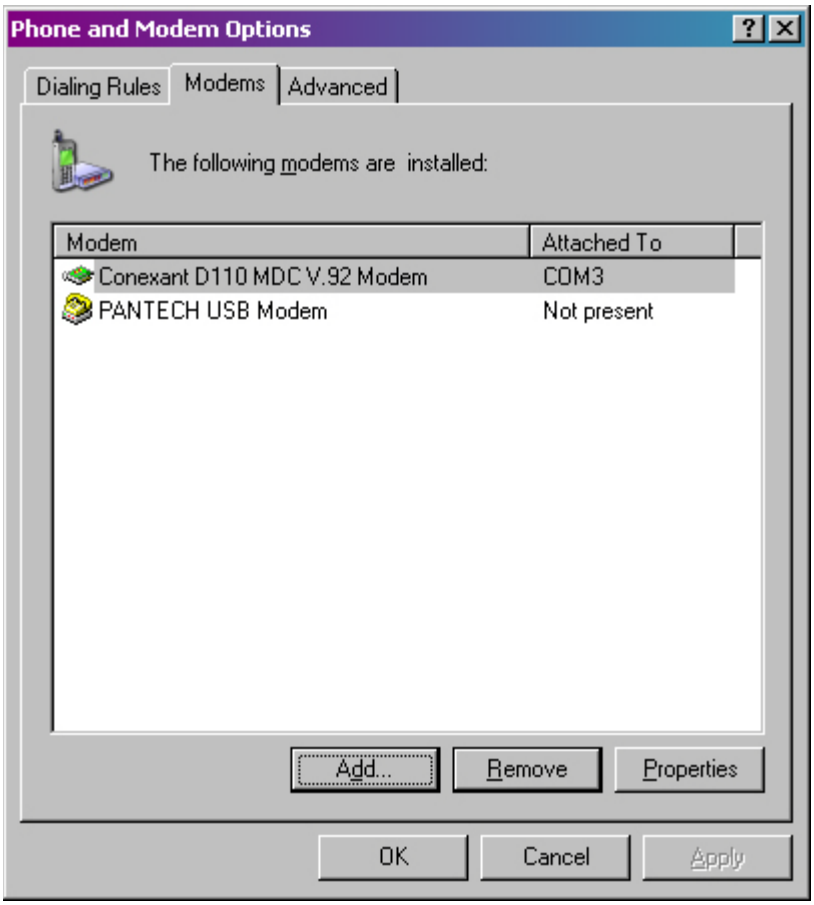
CalAmp Proprietary & Confidential

Windows XP

This set of instructions assumes you are using the 'Classic' view of the Control Panel.

20. Go to **Start**, **Settings**, and click **Control Panel.**
21. Open the **Phone and Modem Options** control.

22. Click the **Modems** tab.

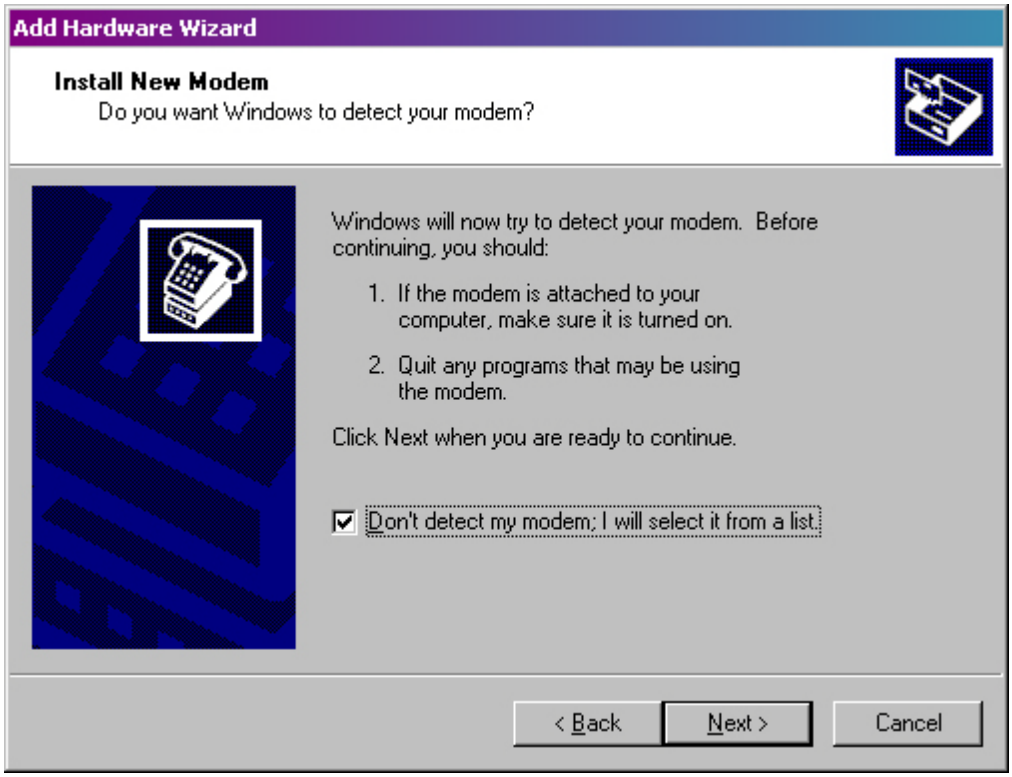


23. Click the **Add…** button

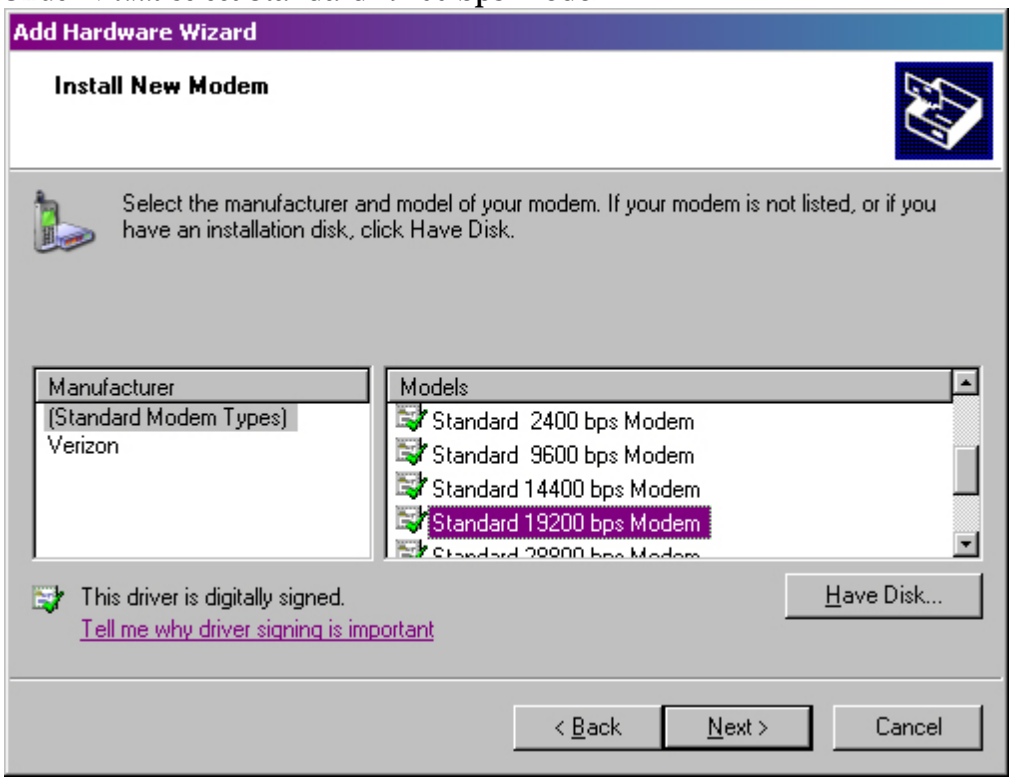
Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

24. Check the **Don't detect my modem; I will select it from a list** option and click the **Next >** button.


Add Hardware Wizard
Install New Modem
Do you want Windows to detect your modem?
Windows will now try to detect your modem. Before continuing, you should:
1. If the modem is attached to your computer, make sure it is turned on.
2. Quit any programs that may be using the modem.
Click Next when you are ready to continue.
Don't detect my modem; I will select it from a list.
< Back
Next >
Cancel

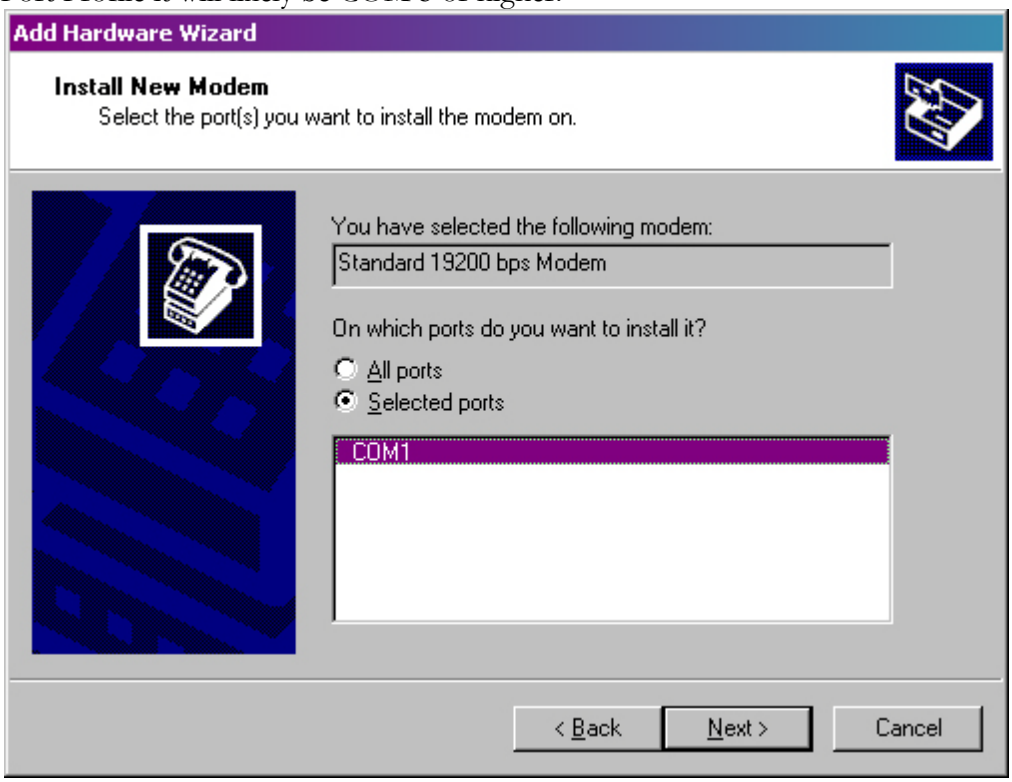
25. Under *Manufacturer* select **(Standard Modem Types)**
26. Under *Models* select **Standard 19200 bps Modem**


Add Hardware Wizard
Install New Modem
Select the manufacturer and model of your modem. If your modem is not listed, or if you have an installation disk, click Have Disk.
Manufacturer
(Standard Modem Types)
Verizon
Models
Standard 2400 bps Modem
Standard 9600 bps Modem
Standard 14400 bps Modem
Standard 19200 bps Modem
This driver is digitally signed.
Tell me why driver signing is important
Have Disk...
< Back
Next >
Cancel

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

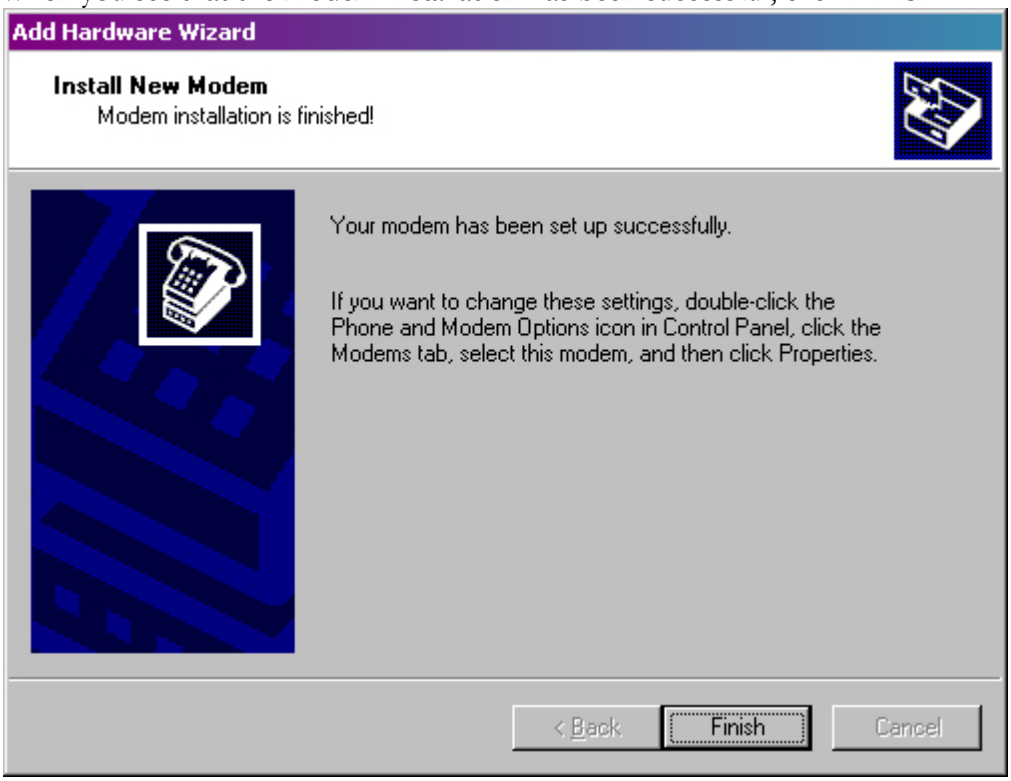
27. Click **Next >**.
28. Click the **Selected Ports** option and then choose the COM Port the LMU-4100™ is connected to. If you are plugged into the back of your laptop, this will generally be COM 1. If you are using a USB to Serial Adapter or a Bluetooth device with a Serial Port Profile it will likely be COM 5 or higher.


Add Hardware Wizard
Install New Modem
Select the port(s) you want to install the modem on.
You have selected the following modem:
Standard 19200 bps Modem
On which ports do you want to install it?
All ports
Selected ports
COM1
< Back
Next >
Cancel

29. Click **Next >**.

Copyright ©CalAmp DataCom Inc 2009

30. When you see that the modem installation has been successful, click **Finish**

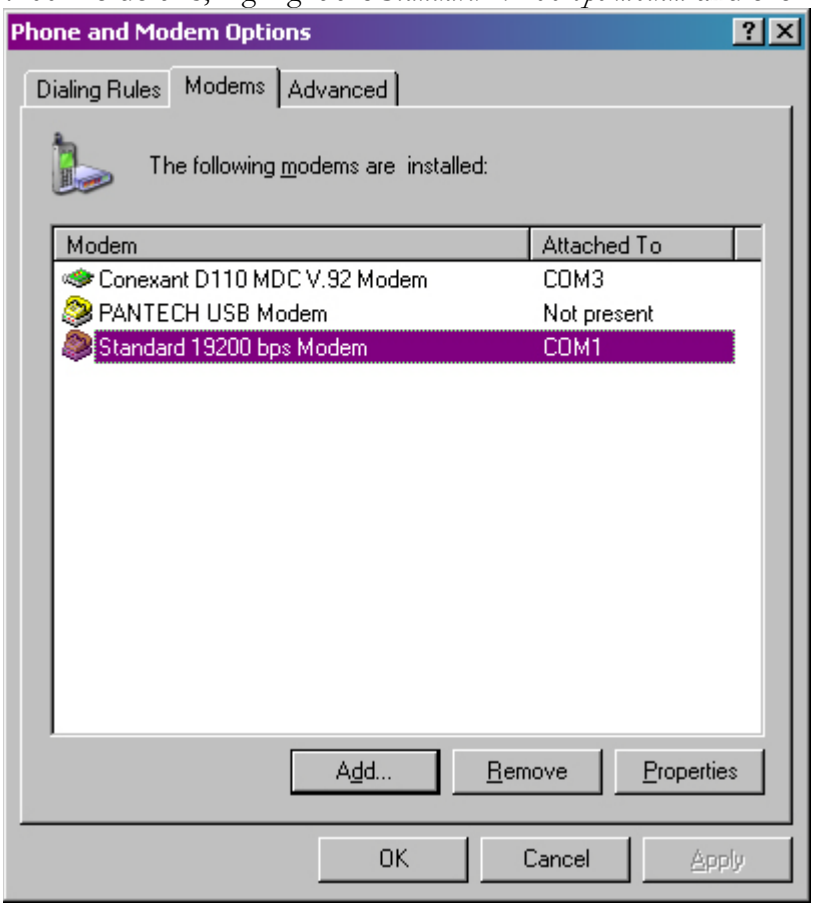

Add Hardware Wizard
Install New Modem
Modem installation is finished!
Your modem has been set up successfully.
If you want to change these settings, double-click the Phone and Modem Options icon in Control Panel, click the Modems tab, select this modem, and then click Properties.
< Back
Finish
Cancel

31. In some cases it may be necessary to change the default BAUD rate associated with the modem. Specifically, it should match the Host Port BAUD rate of the LMU-

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

4100. To do this, highlight the *Standard 19200 bps modem* and click **Properties.**

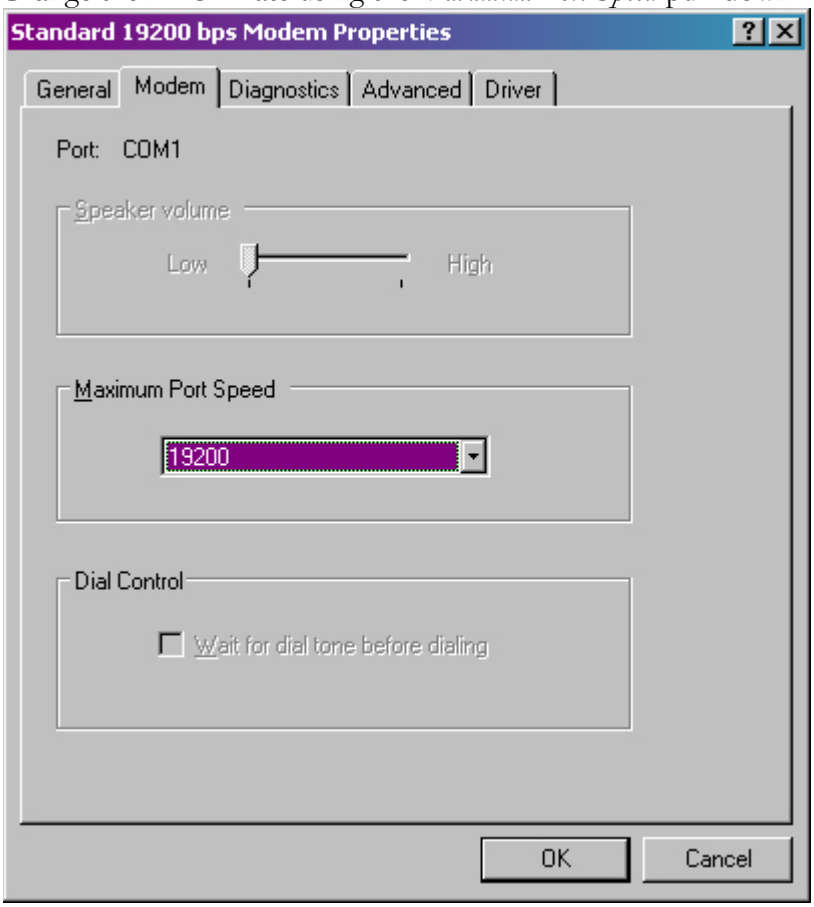


32. Click the **Modem** tab.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

33. Change the BAUD rate using the *Maximum Port Speed* pull-down list.



34. Click **OK** to exit back to the main control panel.
35. Click **OK** to finish.

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Windows Mobile 5.0

Adding a modem into Windows Mobile devices is a little trickier than for a laptop based operating system. Specifically you will need to make an adjustment to the Registry of your Windows Mobile device. You will need to make the following additions:

```
[HKEY_LOCAL_MACHINE\ExtModems\CalAmpLMU]
     "Port"="COM0:"
     "FriendlyName"="CalAmp LMU"
     "DeviceType"=dword:00000001

[HKEY_LOCAL_MACHINE\ExtModems\CalAmpLMU\Settings]

[HKEY_LOCAL_MACHINE\ExtModems\CalAmpLMU\Init]
```

Note that the 'Port' key must match the COM port the LMU is connected to. If the com port is using the sync cable, it is likely COM1. For Bluetooth devices, it must match the Outgoing COM Port associated with the LMU-4100™'s BTA.

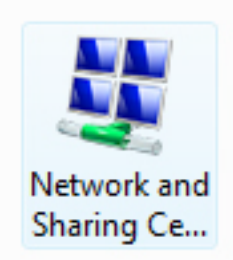
Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

Appendix H – Creating a Dial-Up Networking Session

Windows Vista

1. Go to **Start**, **Settings** and click **Control Panel.**
2. Double click the **Network and Sharing Center** icon.

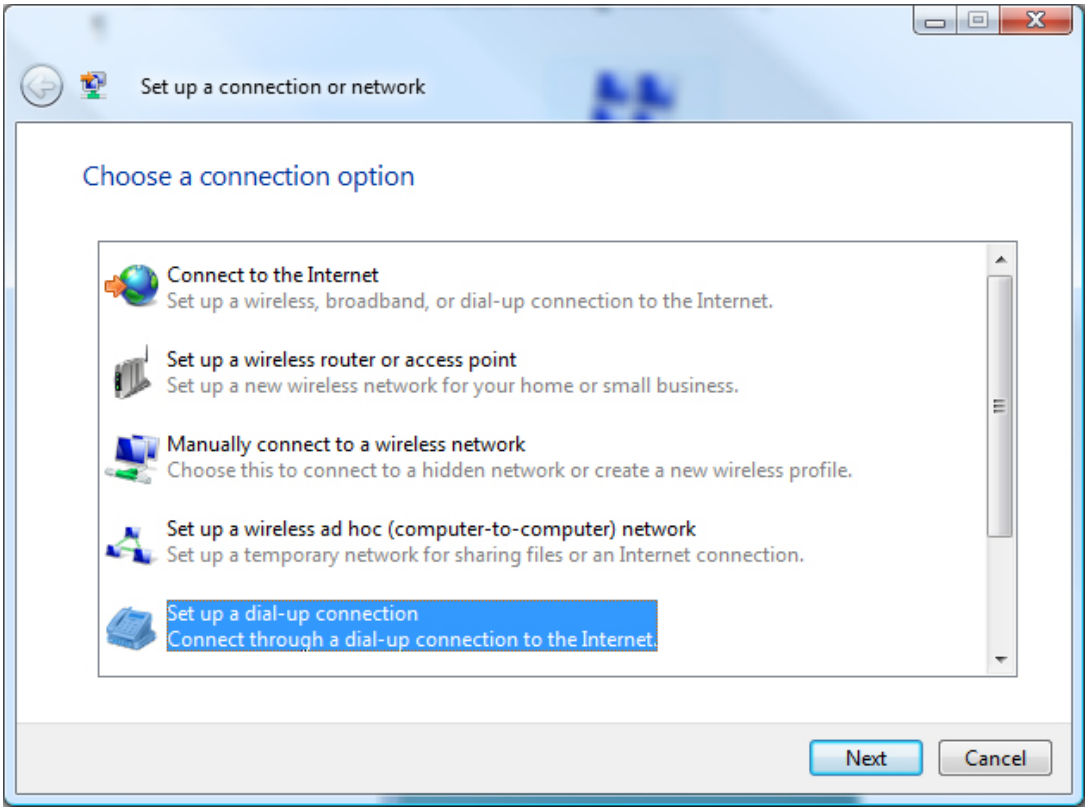


3. Under *Tasks* select **Setup a connection or network**

4. From the list, choose **Setup a dial-up connection** and Click **Next**

Copyright ©CalAmp DataCom Inc 2009

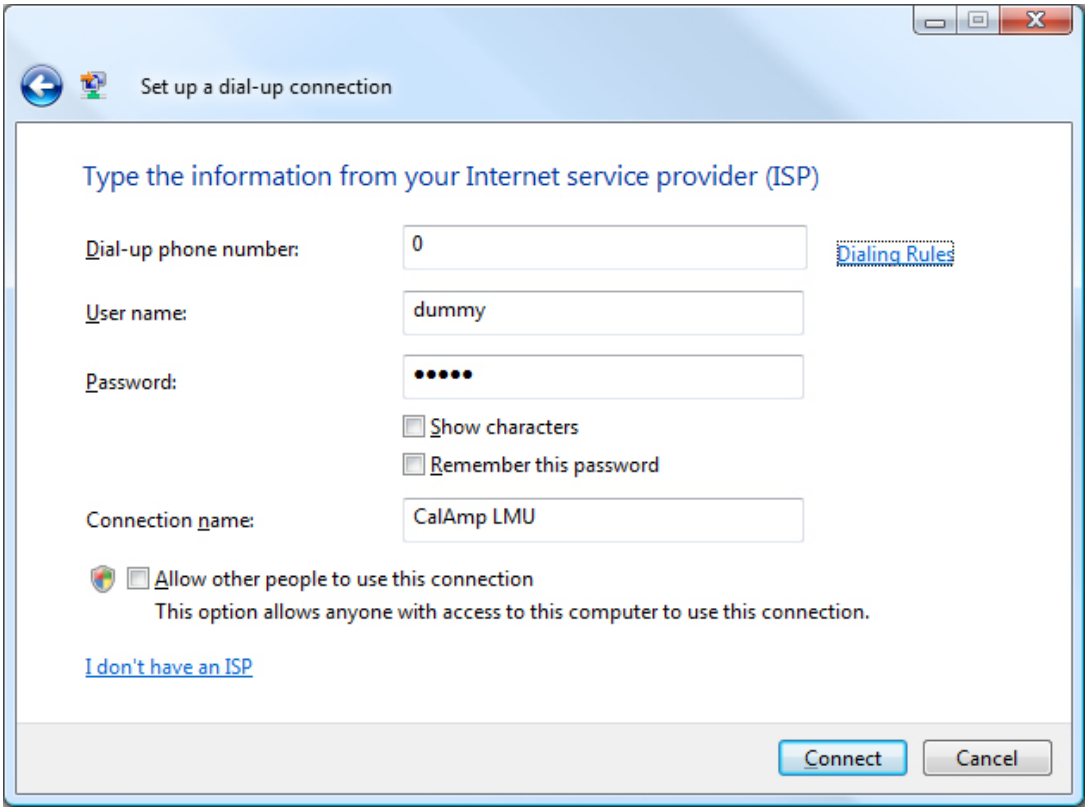
CalAmp Proprietary & Confidential


Set up a connection or network
Choose a connection option
Connect to the Internet
Set up a wireless, broadband, or dial-up connection to the Internet.
Set up a wireless router or access point
Set up a new wireless network for your home or small business.
Manually connect to a wireless network
Choose this to connect to a hidden network or create a new wireless profile.
Set up a wireless ad hoc (computer-to-computer) network
Set up a temporary network for sharing files or an Internet connection.
Set up a dial-up connection
Connect through a dial-up connection to the Internet.
Next
Cancel

5. In the *Dial-up phone number* field enter **0**
6. For *User name* use **dummy**
7. For the *Password* also use **dummy**
8. For *Connection name* use **CalAmp LMU**

Copyright ©CalAmp DataCom Inc 2009

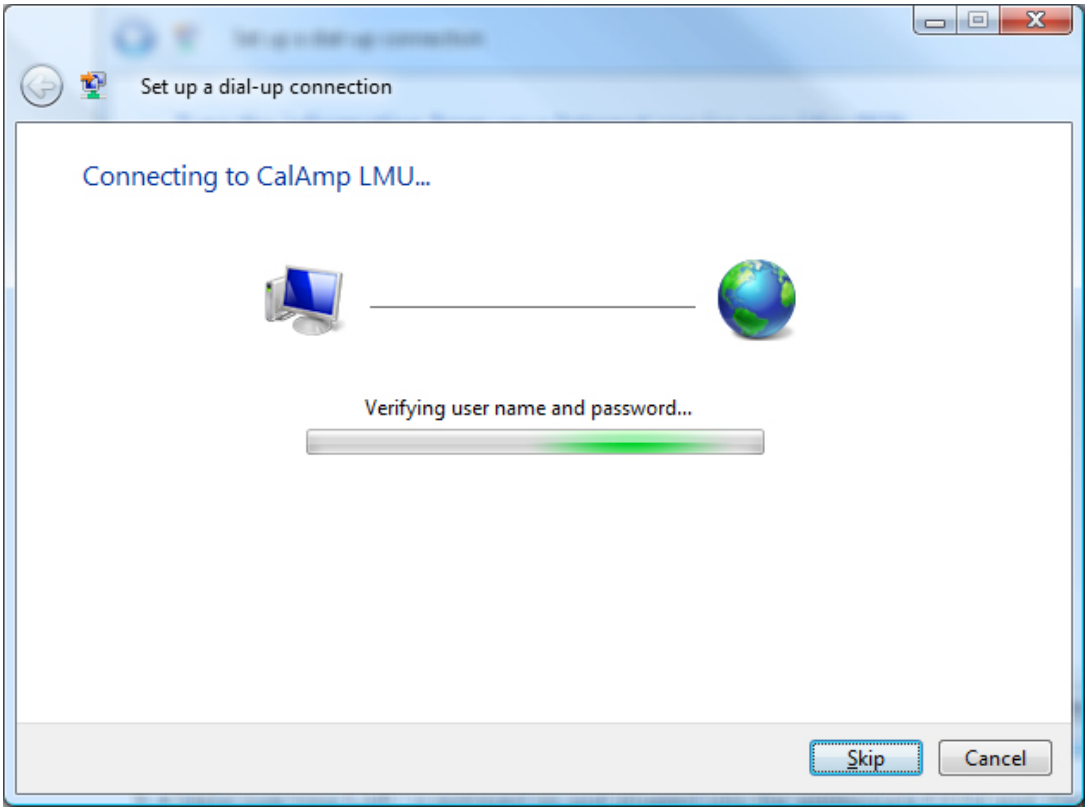
CalAmp Proprietary & Confidential

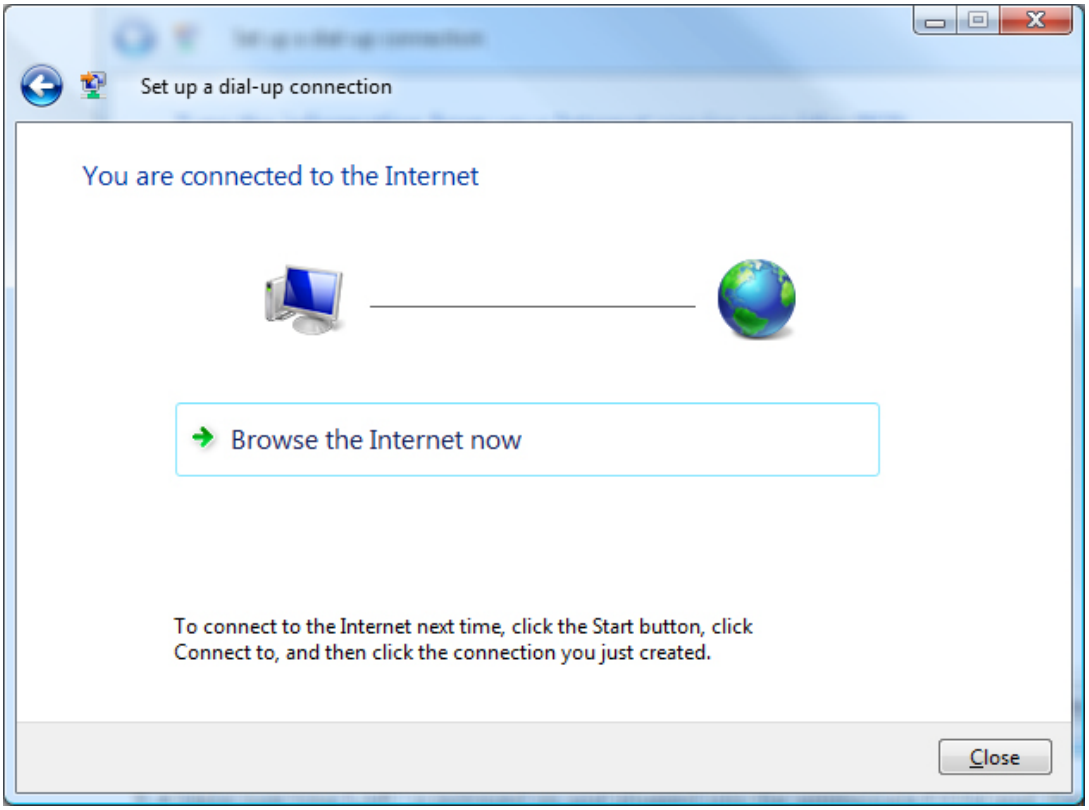


9. Make sure your LMU is powered on and plugged into the appropriate COM port then click **Connect**

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

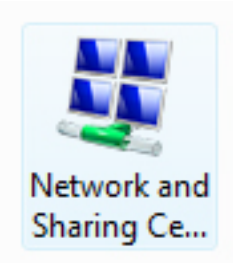



Set up a dial-up connection
You are connected to the Internet
Browse the Internet now
To connect to the Internet next time, click the Start button, click Connect to, and then click the connection you just created.
Close

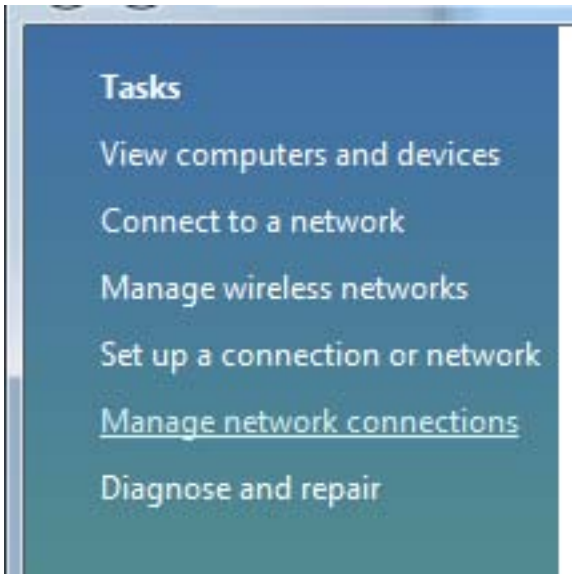
Copyright ©CalAmp DataCom Inc 2009

If the connection fails you may need to edit the Dial-Up Networking connection's properties. This can be done as follows

1. Go to **Start**, **Settings** and click **Control Panel.**
2. Double click the **Network and Sharing Center** icon.



3. Under *Tasks* select **Manage network connections**

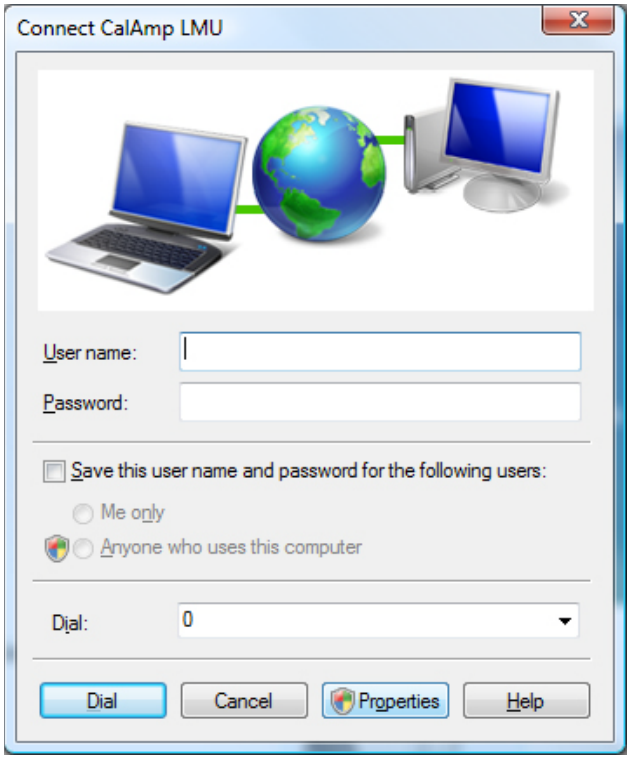


4. Double click the **CalAmp LMU** icon

5. Click the **Properties** button

Copyright ©CalAmp DataCom Inc 2009

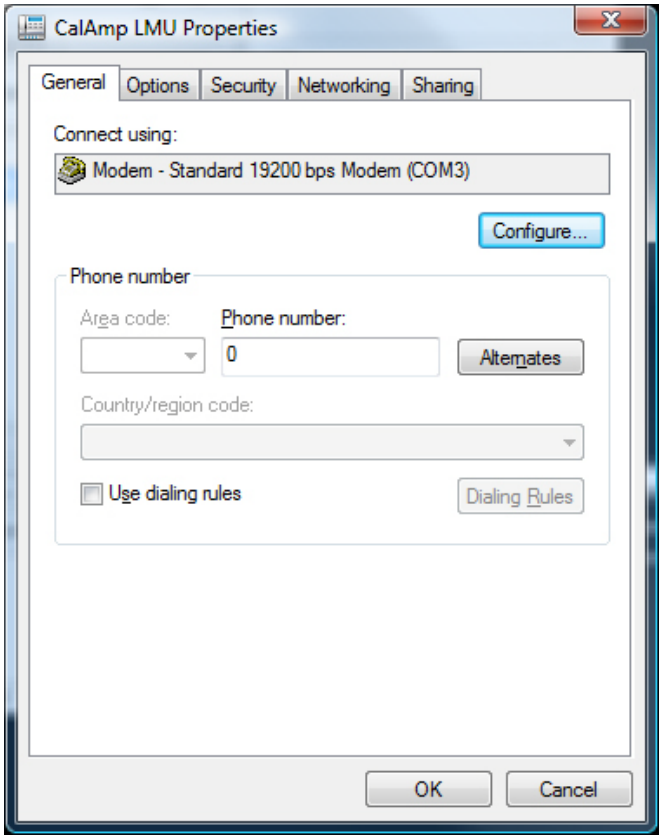
CalAmp Proprietary & Confidential



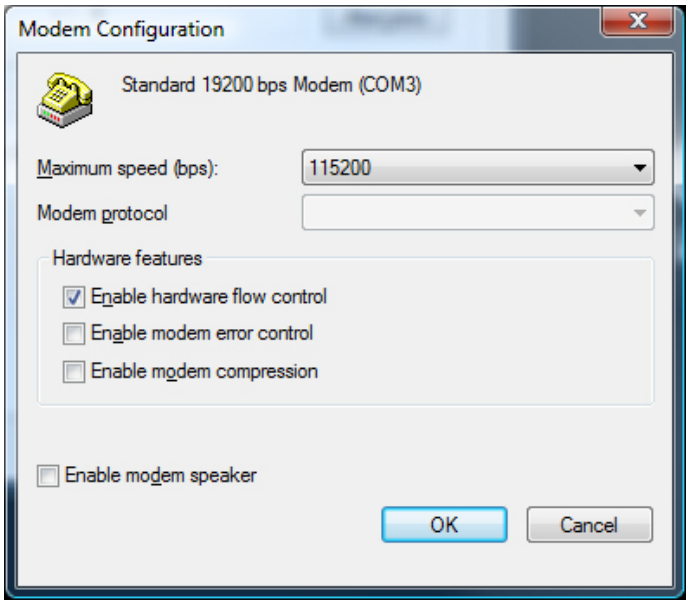
6. Click **Continue**
7. Make sure the *Connect using* field reads a **Modem – Standard 19200 bps Modem (COM<X>)**
8. Make sure the *Phone number* is set to **0**

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential



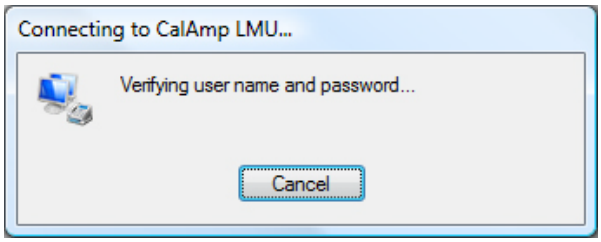
9. Click **Configure…**
10. Make sure *Maximum speed (bps)* is set to **115200**



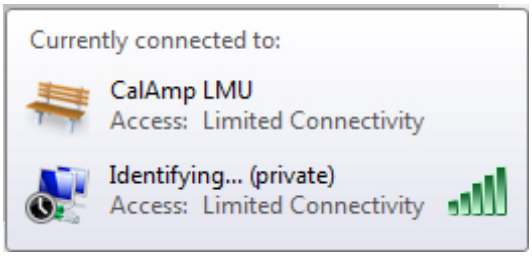
11. Click **OK** to exit the Modem Configuration window
12. Click **OK** again to exit the CalAmp LMU Properties window

Copyright ©CalAmp DataCom Inc 2009

13. Make sure the CalAmp LMU is powered on and connected to the appropriate COM port and click **Dial**



Verify the connection by hovering the mouse over the networking icon in the task tray.



Copyright ©CalAmp DataCom Inc 2009

Windows XP

10. Go to **Start**, **Settings** and click **Control Panel.**
11. Double click the **Network Connections** icon.

12. Under *Network Tasks* select **Create a new connection.**

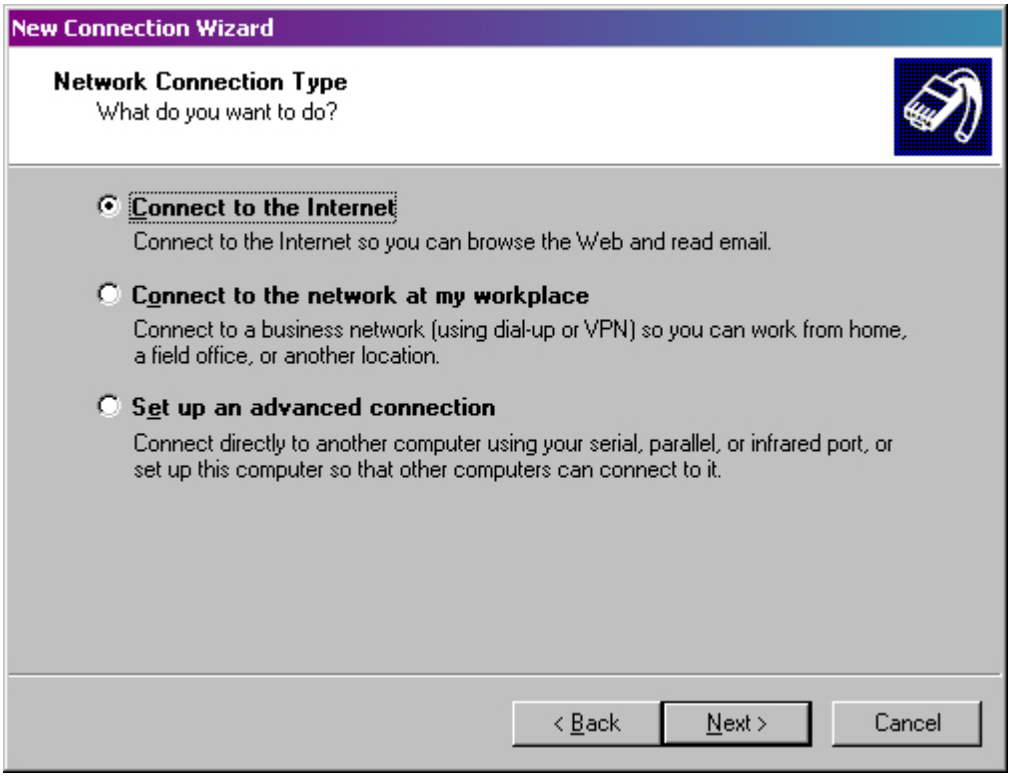
New Connection Wizard
Welcome to the New Connection Wizard
This wizard helps you:
Connect to the Internet.
Connect to a private network, such as your workplace network.
To continue, click Next.
< Back
Next >
Cancel

13. Click **Next >**

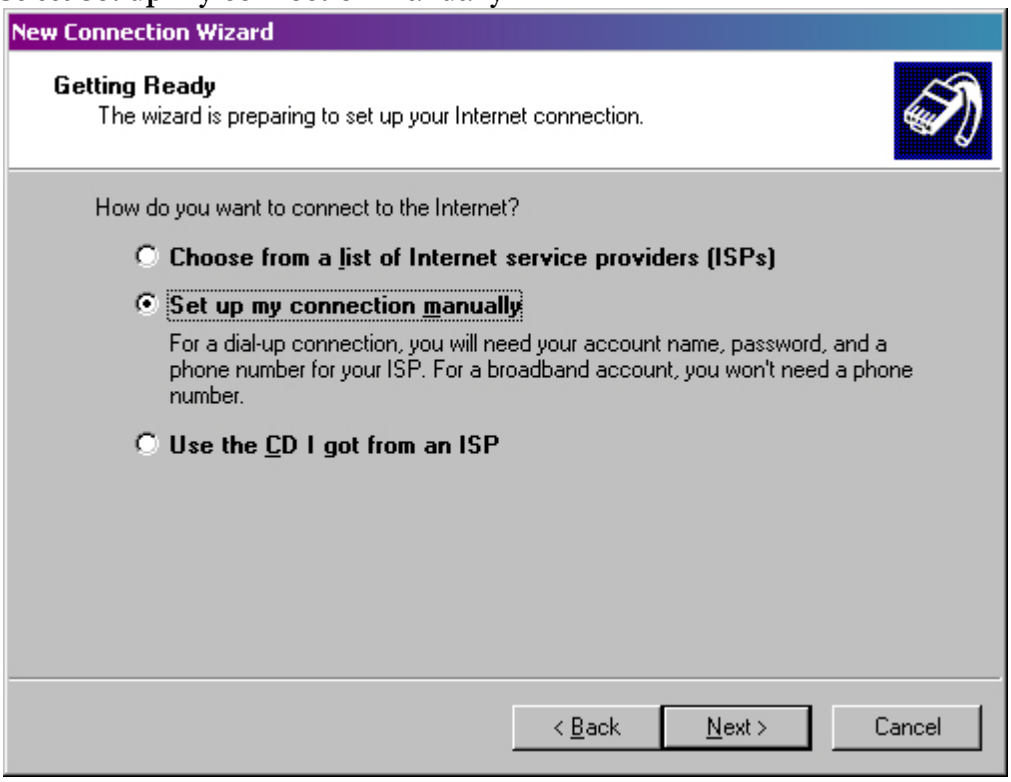
Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

14. Select **Connect to the Internet**


New Connection Wizard
Network Connection Type
What do you want to do?
Connect to the Internet
Connect to the Internet so you can browse the Web and read email.
Connect to the network at my workplace
Connect to a business network (using dial-up or VPN) so you can work from home, a field office, or another location.
Set up an advanced connection
Connect directly to another computer using your serial, parallel, or infrared port, or set up this computer so that other computers can connect to it.
< Back
Next >
Cancel

15. Click **Next >**
16. Select **Set up my connection manually**

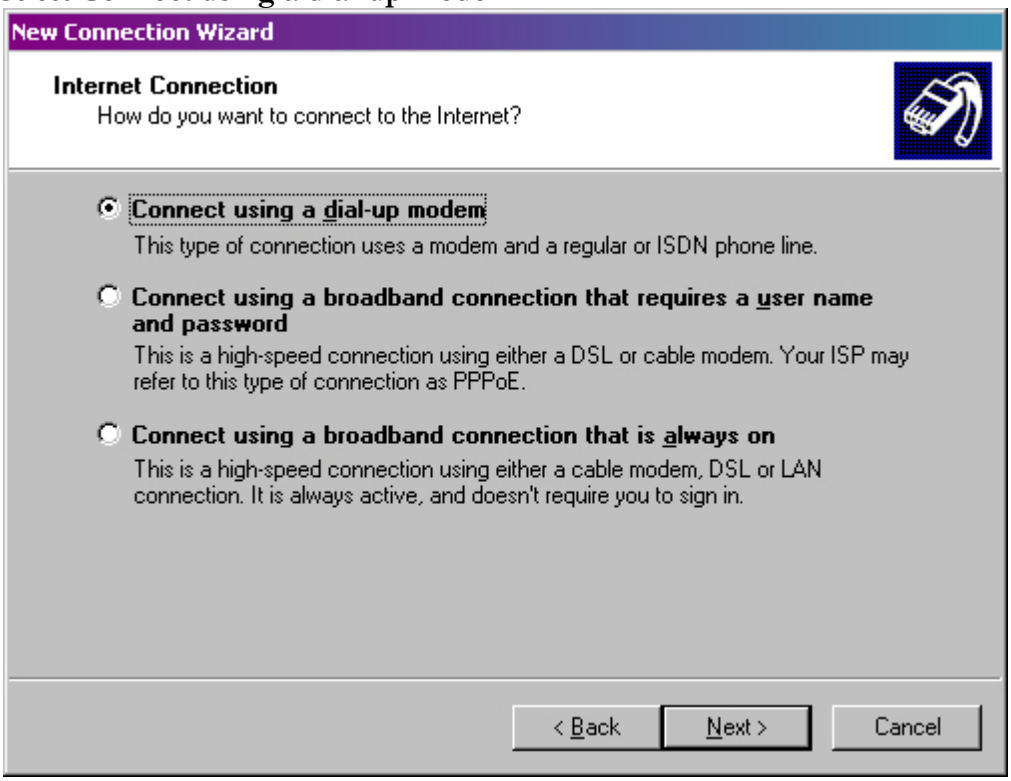

New Connection Wizard
Getting Ready
The wizard is preparing to set up your Internet connection.
How do you want to connect to the Internet?
Choose from a list of Internet service providers (ISPs)
Set up my connection manually
For a dial-up connection, you will need your account name, password, and a phone number for your ISP. For a broadband account, you won't need a phone number.
Use the CD I got from an ISP
< Back
Next >
Cancel

17. Click **Next >**

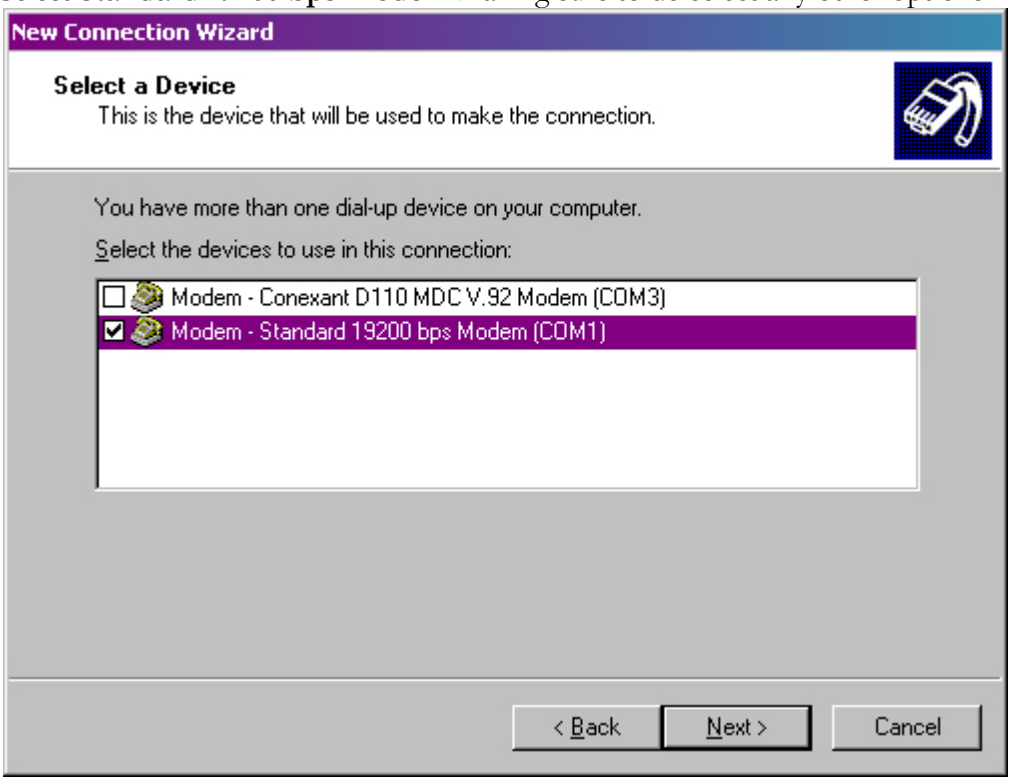
Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

18. Select **Connect using a dial-up modem**


New Connection Wizard
Internet Connection
How do you want to connect to the Internet?
Connect using a dial-up modem
This type of connection uses a modem and a regular or ISDN phone line.
Connect using a broadband connection that requires a user name and password
This is a high-speed connection using either a DSL or cable modem. Your ISP may refer to this type of connection as PPPoE.
Connect using a broadband connection that is always on
This is a high-speed connection using either a cable modem, DSL or LAN connection. It is always active, and doesn't require you to sign in.
< Back
Next >
Cancel

19. Click **Next >**
20. Select **Standard 19200 bps Modem** making sure to de-select any other options.

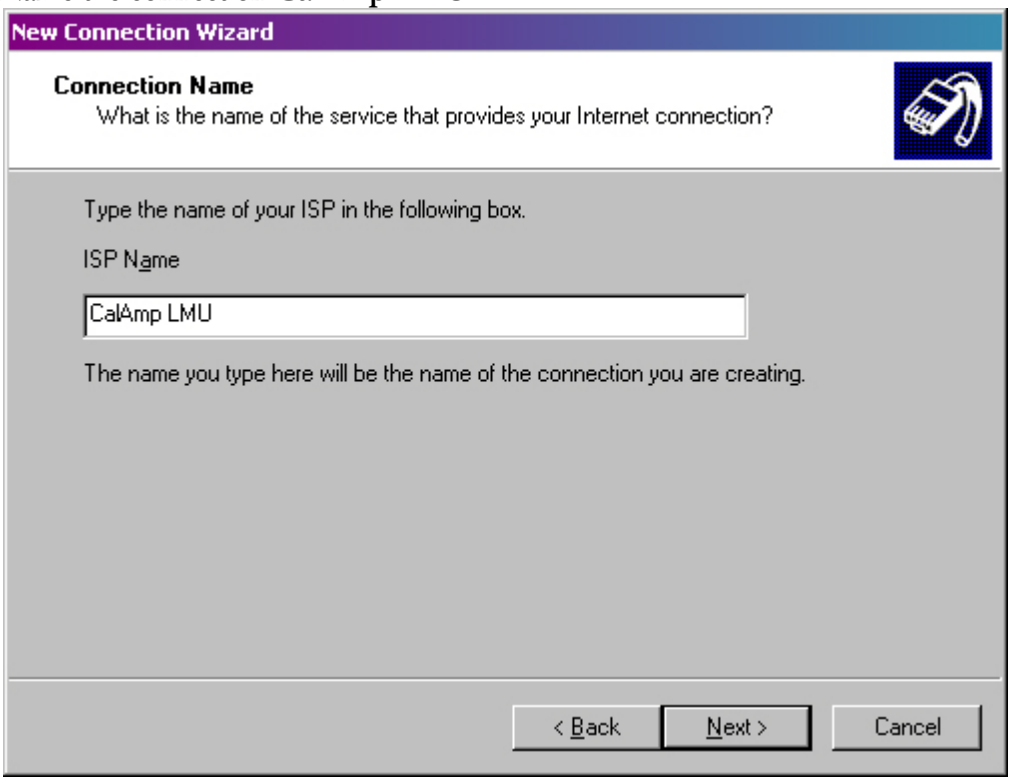

New Connection Wizard
Select a Device
This is the device that will be used to make the connection.
You have more than one dial-up device on your computer.
Select the devices to use in this connection:
Modem - Conexant D110 MDC V.92 Modem (COM3)
Modem - Standard 19200 bps Modem (COM1)
< Back
Next >
Cancel

21. Click **Next >**

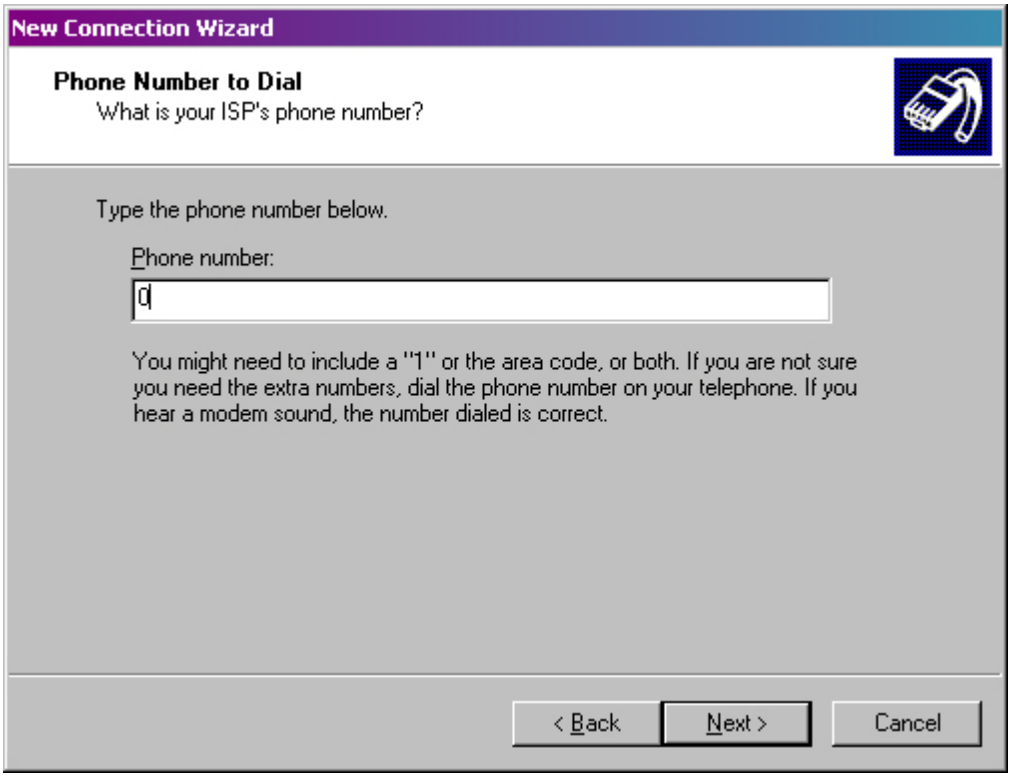
Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

22. Name the connection **CalAmp LMU**


New Connection Wizard
Connection Name
What is the name of the service that provides your Internet connection?
Type the name of your ISP in the following box.
ISP Name
CalAmp LMU
The name you type here will be the name of the connection you are creating.
< Back
Next >
Cancel

23. Click **Next >**
24. Set the *Phone Number* to **0**.

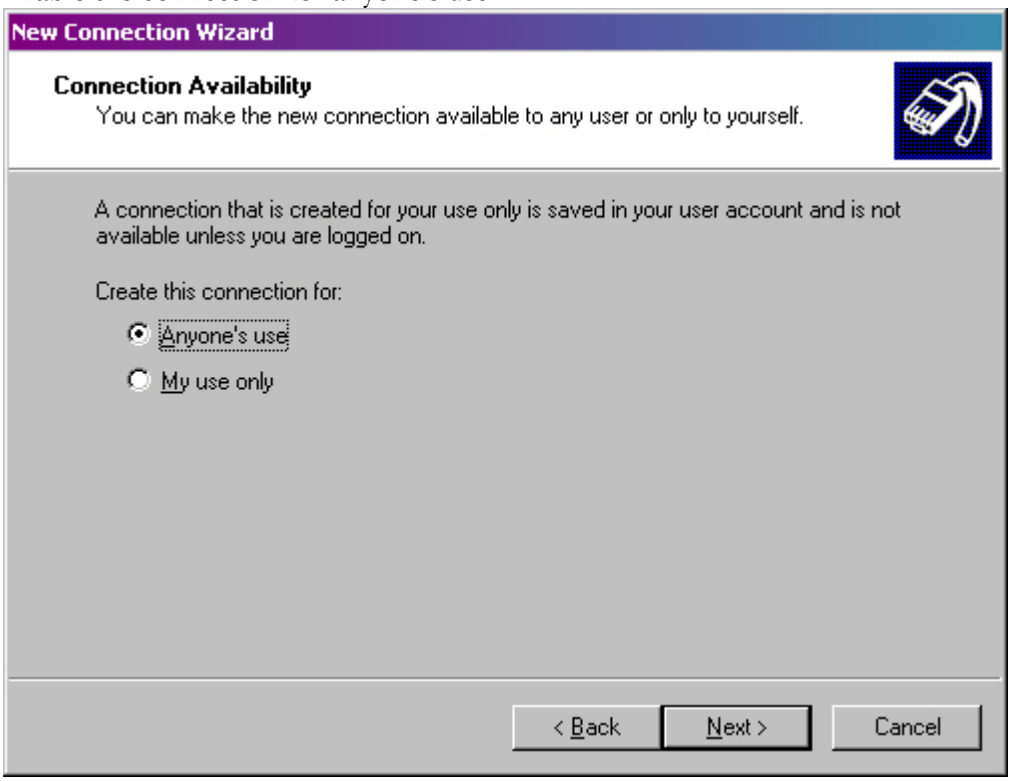

New Connection Wizard
Phone Number to Dial
What is your ISP's phone number?
Type the phone number below.
Phone number:
0
You might need to include a "1" or the area code, or both. If you are not sure you need the extra numbers, dial the phone number on your telephone. If you hear a modem sound, the number dialed is correct.
< Back
Next >
Cancel

25. Click **Next >**

Copyright ©CalAmp DataCom Inc 2009

CalAmp Proprietary & Confidential

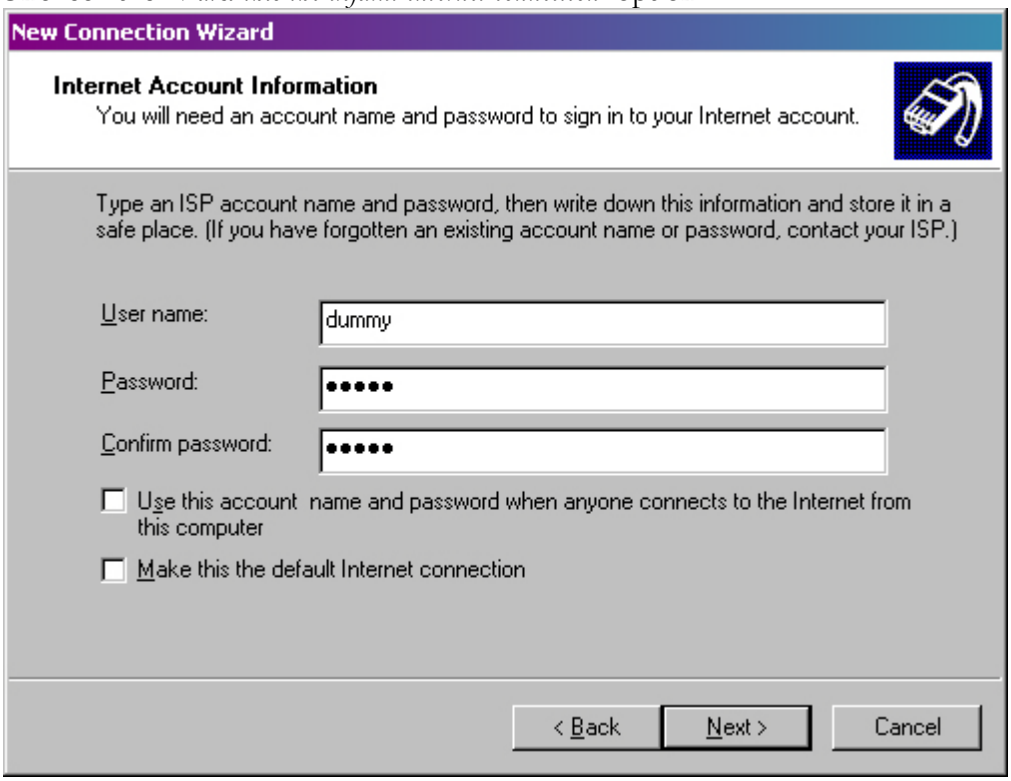
26. Enable the connection for anyone's use.


New Connection Wizard
Connection Availability
You can make the new connection available to any user or only to yourself.
A connection that is created for your use only is saved in your user account and is not available unless you are logged on.
Create this connection for:
Anyone's use
My use only
< Back
Next >
Cancel

27. Click **Next >**
28. Enter '**dummy'** for both the *Username* and *Password.*
29. Uncheck the '*Use this account name and password when anyone connects to the Internet from this computer'* option.

Copyright ©CalAmp DataCom Inc 2009

30. Uncheck the '*Make this the default internet connection*' option.


New Connection Wizard
Internet Account Information
You will need an account name and password to sign in to your Internet account.
Type an ISP account name and password, then write down this information and store it in a safe place. (If you have forgotten an existing account name or password, contact your ISP.)
User name:
dummy
Password:
Confirm password:
Use this account name and password when anyone connects to the Internet from this computer
Make this the default Internet connection
< Back
Next >
Cancel

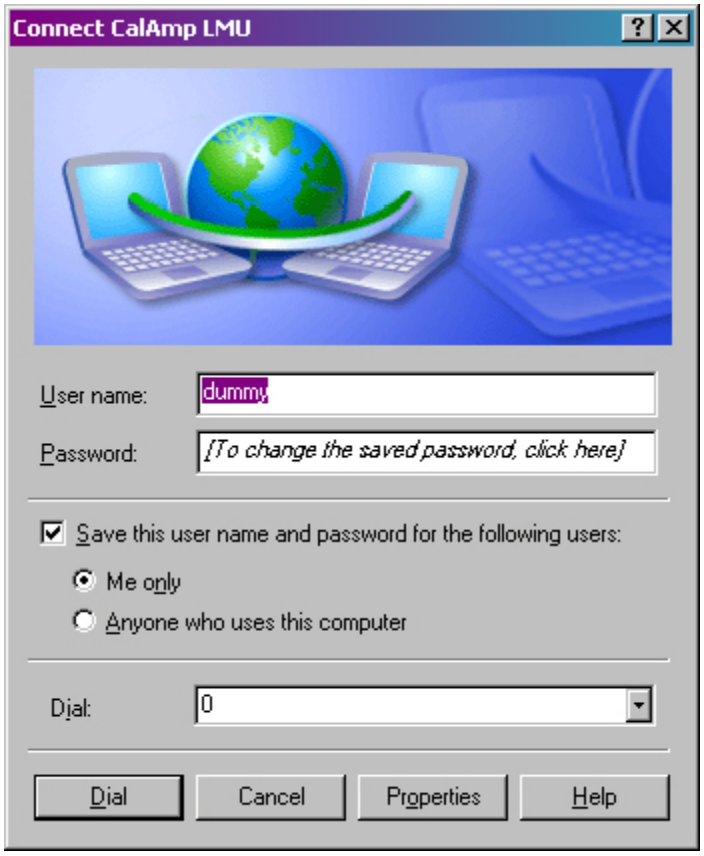
31. Click **Next >**

New Connection Wizard
Completing the New Connection Wizard
You have successfully completed the steps needed to create the following connection:
CalAmp LMU
Share with all users of this computer
The connection will be saved in the Network Connections folder.
Add a shortcut to this connection to my desktop
To create the connection and close this wizard, click Finish.
< Back
Finish
Cancel

Copyright ©CalAmp DataCom Inc 2009

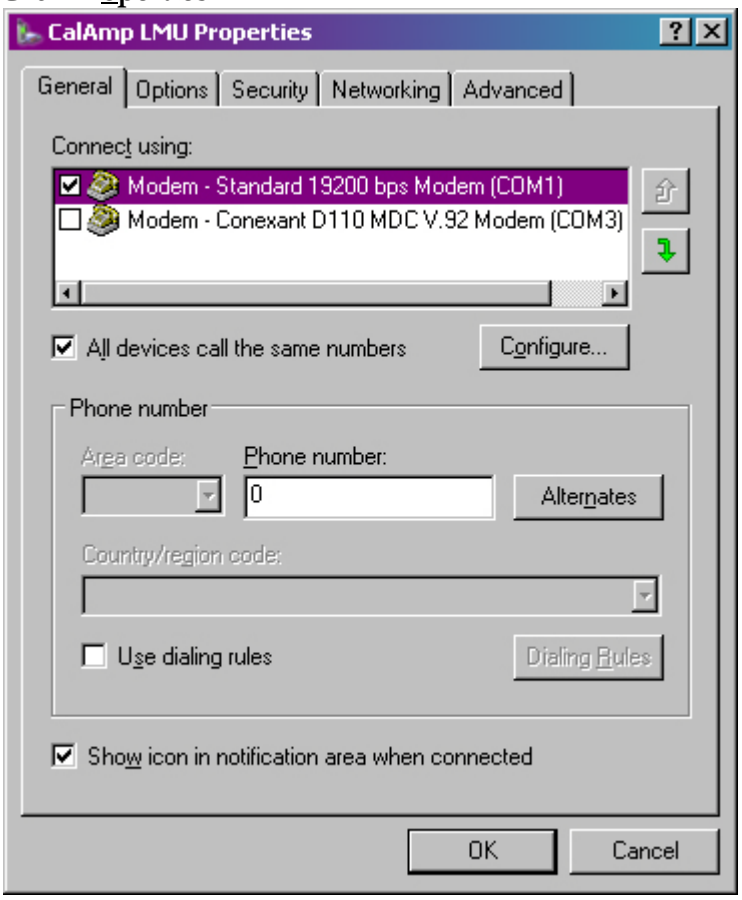
CalAmp Proprietary & Confidential

32. Click **Finish**



Copyright ©CalAmp DataCom Inc 2009

33. Click **Properties**



34. Click **Configure**
35. Change the *Maximum Speed (bps)* to match the BAUD rate you selected when you created the Standard 19200 bps Modem.
36. Click **OK**
37. Click **OK**
38. Make sure the LMU-4100 is connected to the appropriate COM port, is powered on and is registered to the wireless network.
39. Click **Dial**

You should now be connected to the Internet via the LMU.

Copyright ©CalAmp DataCom Inc 2009

Windows Mobile

1. Go to **Start** -> **Settings** and click the **Connections** tab.
2. Tap the **Add a new modem connection** link.
3. Name the connection **LMU**
4. Under *Select a modem* choose **CalAmp LMU(i.e. the same modem driver you created above)**
5. Tap **Next**
6. For the phone number use **0** and tap **Next**
7. You don't need to bother with a Username, Password or Domain.
8. Click **Advanced**.
9. If you are using a direct serial connection, make sure the **Baud rate** matches what you're using on the LMU (e.g. 57600)
10. Click **Ok**.
11. Click **Finish**

Copyright ©CalAmp DataCom Inc 2009